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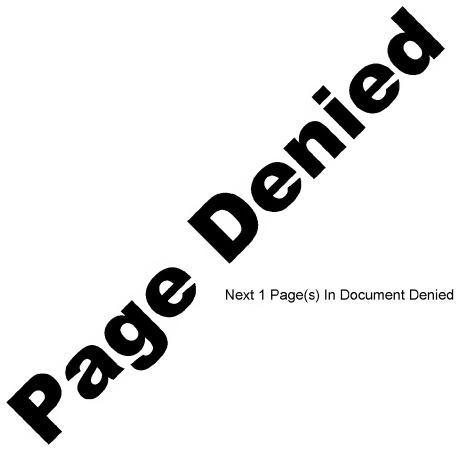

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TRAINING OF PARACHUTISTS, BY B. PETROV, N. LOBANOV, A. BELOUSOV

The book "Training of Parachutists" is intended as a manual for the trainees in the aeroclubs and circles of DOSAAF and for the directors of parachute training.

The book gives a brief history of the development of Soviet Parachutism, the principles of the theory of jumping with a parachute, descriptions of the parts of the present day Soviet parachutes, the packing of them, the rules for employment and the making of jumps with the parachute.

The book has at the end some instructions concerning methods of training of parachutists.

The following persons participated in the elaboration of the manual: Sportsmaster A. Belousov and N. Petrov--Chapter I; laureate of the Stalin prize, Candidate of Technical Science, Sportsmaster N. Lobanov, Chapter II--; honored master of /Sports B. Petrov, Chapters 3-9.

Opinions, appraisals and remarks concerning the book should be sent to the publishing house of Dosaaf, Moscow. 26 Novo-Ryazanskaya Ulitsa.

CHAPTER I

HISTORY OF SOVIET PARACHUTISM

The Soviet people, under the direction of the Communist Party and the Soviet Government, has created in a brief historical period a leading aviation and parachute industry, developed aviation science and technology, and has converted our country into a great air power.

The achievements of the Soviet people have also been great in the field of aviation sport, particularly in parachute sport. Thousands of young men and women have participated with enthusiasm in parachute sport. All the highest achievements in the field of parachutism belong to Soviet sportsmen.

Marshal of the Soviet Union K.E. Voroshilov, in addressing the First All-Union Conference of Stakhanovites in 1935, made the following statement:

".....Parachutism is a field of aviation in which the Soviet Union has a monopoly. There is not a country in the world which can say that it is able to equal the Soviet Union even approximately in this field, or much less that it stands a chance of overtaking us in the near future, to say nothing of having a chance to outstrip us. At the present there are no such countries in the world. And I shall not be mistaken--and this is not conceit--if I say that there will not be any until in other countries there is a Soviet Power".

Since the time these words were spoken, parachute sport in our country has registered still greater and grandiose progress. It has become a true mass form of sport. Soviet parachutists continue to perfect their sport skill, and, having achieved world leadership, are now moving forward to still further successes.

Even long ago the Russian people were outstanding in their efforts to master the air. It can be proved in an irrefutable manner that our fatherland is the home of aerostation, aviation, and parachutism. The Russian people created the first flying machines in the world: the balloon, the helicopter, the airplane, and the pack parachute.

In the writings of Sulakadzev "Flying in the Air in Russia since 906 A.D." he read that"...in 1731 in Ryazan, a minor official of Nerekhta by the name of Ignatiuty made a large spherical sack, filled it with smoke--suspended a loop from it, sat in it and rose higher than the birches".

Hence, the honor of the invention of the balloon and the first flight in it belongs to a Russian.

In 1754 the brilliant Russian scientist, M.V. Lomonosov invented and constructed the model of the first helicopter in the world. By his invention Lomonosov proved that machines heavier than air can fly by means of a screw propeller.

Lastly, the Russian scientist and inventor A.F. Mozhaiskii, in 1882-1885, constructed the first airplane in the world and tested it in flight.

Our country was the first to create and test gliders and hydroplanes. Our country is the homeland of heavy airplanes. Russia was the first country in the world to construct multiengine heavy airplanes(The "Russkii Vityaz", "Ilya Murometz", and "Svyatogor").....

By their remarkable exploits the Russian flyers Nesterov, Brutsen, Artseulov, Popov, Efimov, and later on, in our time, Chkalov, Gromov, Pokryshkin, Koshedub, Gastello and many others have made their fatherland famous.

P.N. Nesterov was the initiator of superior pilotage. He was the first in the world to calculate scientifically the normal loop, called after him the "Nesterov loop", and he executed it in 1913. In 1914 Nesterov became the first in the history of the world to conduct an air battle, finishing it by ramming the airplane of the enemy.

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The aviator [illegible] Kruten perfected the methods of maneuver in air battle, formulated the tactical principles of fighter aviation and personally shot down in air battle 15 planes of the enemy.

The aviator K. K. Artseulov was the first in the world to work out a method for bringing an airplane out of a corkscrew spin and on 24 September 1916 he carried it out in practice.

Among the exploits of Soviet fliers inscribed with golden letters in the history of the Soviet Air Force are the rescue of the Cheliuskins, the flight of V. Chkalov over the North [illegible], the flight of the scientific expedition to the North Pole, the historical flights of the crews of V. Chkalov and M. Gromov from Moscow across the North Pole to the USA, the altitude flights of V. Kokkinaki, the flight of the crew of the airplane Rodina — V. Grizodubova, P. Osipenko and M. Raskova.

In the years of the Great Patriotic War, Soviet aviation travelled a [illegible] path. [illegible] displayed in full measure the [illegible] of our aviation, the [illegible] of combat skill of Soviet aviators. For outstanding combat exploits, [illegible] aviators were awarded the title of Hero of the Soviet Union, [illegible] were awarded the title of Hero of the Soviet Union twice and two glorious fliers, A. I. Pokryshkin, who shot down 59 enemy airplanes, and I. N. Kozhedub, who shot down 62 enemy airplanes, were awarded the title of Hero of the Soviet Union three times.

It has been proved irrefutably that [illegible] scientific-technical ideas of Russian and Soviet scientists and constructors have always outstripped a great deal the aviation science and technique of the countries of Western Europe and the USA. This applies in full measure to the creation of [illegible] parachute technique.

The honor of working out the construction of the first pack parachute, the design principle of which is the basis of all present day parachutes, belongs to the talented Russian constructor and inventor G. E. Kotelnikov.

The present day parachute appeared as a result of the attempt to find a method which would make it possible to ensure the safety of flights. The idea itself of employing a special device for dropping from a height appeared even before there were any flying machines.

The history of the Russian people has many legends and [illegible]

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folklore story) about people who flew in the air. For example, in the manuscript of Daniil Zatochnik, belonging to the 13th century, there are statements about the flight of Slavs at the time of the national festivals and amusements. The author describes cases of flying on silk wings from high structures. Dating from the second half of the 16th century there is the story of "The Peasant Nikitko", who made a successful flight on wings around Aleksandrovsky suburb near Moscow (now the town of Aleksandrov). In one of the documents dating from the 30's of the 18th century there is mentioned the descent of the "priest's son" Simeon on a curious apparatus constructed by him of wood, paper and skin, the prototype of the parachute.

Historical facts confirm that even long before the creation of the balloon, glider and airplane the idea of the creation of an apparatus making it possible for a man to descend successfully from a height to the ground had already been practically realized in Russia.

The victory of man over the air space led to the rapid development of aerostation and aviation. However, along with the reports concerning the new achievements in aviation it was not infrequently necessary to report the death of daring balloonists and aviators.

During the time of the First World War, for observation of the enemy and the correction of artillery fire, extensive use was made of sausage balloons. These envelopes were filled with a light inflammable gas—hydrogen. The captive sausage balloons served as an excellent target for enemy airplanes. Aviators often attacked them in the air and shot them down with incendiary bullets and even shells. Just one such bullet, to say nothing of a shell, was sufficient to set fire to the balloon and at the same time bring down the observer; and it was then that the parachute came to the rescue of the aerial observer.

In Russia, in the period 1910-1911, the inventors Kotelnikov, Pomortsev and others worked on the construction of a parachute. For equipping aviators of heavy bombers of the type "Ilya Muromets" and the observers of captive balloons one adopted in 1915 the parachute of G.E. Kotelnikov.

However, in spite of the cases of the saving of observers jumping from the balloons, the leadership of Russian air forces always resisted the introduction of parachutes. The reasons advanced for this were very strange: it was claimed that

the aviators, upon the appearance of the least danger as a result of a threat by the enemy, would save themselves by jumping with the parachute and allow the airplane to be lost. This was a calumny against Russian aviators.

The Czarist officials, having suffocated every display of creative ability of the people, placed all kinds of obstacles in the way of an extensive employment of the parachute and in the end the remarkable invention of Kotelnikov was buried in the archives.

The history of the creation of the first pack parachute in the world and certain data of the biography of G.E. Kotelnikov will be of interest for Soviet parachutists.

Gleb Evgenevich Kotelnikov was born 13 January (Old style) 1872 in St. Petersburg, into the family of a professor of mechanics and higher mathematics. From an early age he showed an unusual interest in technology, particularly in aviation, which was only starting to develop in Russia.

Aviators at that time flew in primitive airplanes which were far from being perfect and had no technical means for rescue in case of an accident.

The idea of the creation of a rescue apparatus for aviation rose in the mind of G. E. Kotelnikov in connection with the tragic death of the aviator L. Matsievich, who had a wreck on the Komendantsky Airport in St. Petersburg, in September 1910. Among the many other spectators present at the time at the airport there was G. E. Kotelnikov who was a witness of this first air catastrophe.

G. E. Kotelnikov had to spend a great deal of energy before he made his idea a living reality. The parachutes used at that time in aerostation were clumsy and by reason of their construction not suited for employment in aviation. The attempts of foreign constructors to create a reliable aviation parachute had been unsuccessful.

After stubborn and painstaking work, Kotelnikov succeeded in making some miniature models of pack parachutes. The successful experiments with the models, carried out in the villa locality of Strelen near St. Petersburg and at Novgorod, convinced the inventor that he was on the right path. Kotelnikov after successful tests of the model of the parachute applied for a patent on his invention.

On 27 October (9 Nov) 1911 G.E. Kotelnikov was issued a certificate of application for a patent on a "rescue pack for aviators with an automatic drop

parachute invented by him". (The first specimen of the parachute model of 1911, made by hand by the inventor G.E. Kotelnikov himself and tried out by him in Novgorod, is conserved in the Frunze Central Palace of Aviation and Anti-Aircraft Defense in Moscow).

Kotelnikov offered his invention to the War Department and here he met his first failure. The short-sighted and sluggish Czarist officials rejected the parachute as something that was useless.

However, the persistent inventor did not lose courage. He decided to construct a parachute in natural size, feeling that after a demonstration of the working of the parachute in the air it would certainly be adopted in aviation.

But, on the path towards realization of this decision there arose some serious obstacles. Money was necessary and this the inventor did not have. He had to make use of the services of a private trading firm, which proposed to the inventor to finance the construction of test parachutes "free of charge" and these test parachutes were soon constructed.

The testing of the two experimental parachutes was carried out in the village of Saliuwa (now the village of Kotelnikov) near Tatchina on 6(19) June 1912 from a captive balloon. In September 1912, one parachute was tested from an airplane in Gatchina, and another in Sevastopol. The tests were fully successful and showed a good quality of parachute.

In the Russian press and foreign press there appeared highly favorable appraisals of the Russian inventor and the successful results of his tests. However, the War Ministry, just as before, continued to remain silent and did not show any interest in the Russian inventor and his invention.

In 1912, experimental parachutes were taken with the consent of G.E. Kotelnikov, to Paris to the International Parachute Contest. Here they were demonstrated before the representatives of the Paris Aero Club, after which a student of the St. Petersburg Conservatory, V. Ossovsky, with a parachute of Kotelnikov, made a jump into water from a bridge at Rouen, having a height of 53 meters.

The parachutes of G.E. Kotelnikov, for some unknown reasons, were not returned from France, but there soon began to appear in certain foreign countries aviation pack parachutes in which one used in full the principles of operation and construction of the basic parts of the Russian aviation pack parachute of G.E. Kotelnikov.

At the beginning of the World War 1914-1918, there was constructed in Russia a squadron of heavy bombers of the type "Ilya Muromets". The aviators of these airplanes insistently demanded that the parachute system of Kotelnikov be made a part of the equipment of the crews. There was nothing else for the War Department to do except to propose to the inventor that he construct aviation pack parachutes.

With great energy the inventor set to work. By the middle of 1915 nearly all the detachments of the "Ilya Muromets" bombers were equipped with his parachutes. Later, the parachute of Kotelnikov was employed in the aerostat units under battle conditions and helped to save the life of many balloonists.

It would have seemed that now the parachute of Kotelnikov would have been given final recognition in the leading circles of the War Ministry. But it did not happen this way. The Czarist government thought it necessary to purchase in France the needed parachutes, even though they were much inferior in quality to the parachute of Kotelnikov.

It was not until after the great October Socialist Revolution that one put an end to the tortures of the inventor G.E. Kotelnikov.

In 1918, the parachutes of Kotelnikov passed severe tests in the "Air Laboratory" by the leading professor N.E. Zhukovsk. It was found that the parachute of Kotelnikov was much superior in quality to the French parachute. In 1921, an appraisal commission with the Supreme Council of the People's Economy, after examining the parachute of G.E. Kotelnikov, also noted its superiority in comparison with the French parachute and decided to award the inventor.

Kotelnikov, encouraged by the recognition of his labors, continued his work to improve the first model of the aviation pack parachute with a rigid metallic pack. He called his first pack parachute the RK, an abbreviation of Russian-Kotelnikov--Model 1. In 1923, he constructed a new improved model of the semi-rigid pack. The metallic pack was replaced by canvas, with a rigid back, collapsible side walls, and a soft cover. This parachute, called the RK-2 passed the test in the balloon park in the town of Kuntsevo near Moscow and gave excellent results. However, the inventor continued to work on further improvement of the parachute RK-2.

In 1924, he proposed a pack of soft construction having the form of an unfolded envelope. This pack had side and end flaps, pack rubbers on the flaps, cells on the bottom of the pack and a rip cord with a ring and closing pins. The parachute

of the new model of pack was called by the inventor RK-3.

The work of G.P. Kotelnikov did not pass unnoticed abroad. A year after the creation of the parachute RK-3, there appeared the American parachute Irving, which copied in every detail the parachute RK-3 of Kotelnikov. This Russian aviation pack parachute served as a basis for the construction of all the present day types of aviation parachutes.

In 1924, the inventor constructed and tested the cargo parachute RK-4, designed for dropping cargoes with a weight up to 300 kg. The original mechanical construction made it possible to drop by parachute a balloon basket with a crew and all of its equipment.

G.E. Kotelnikov also proposed the design of the small cargo parachute called by the inventor "Air postman". It was designed for the dropping of small bundles of mail.

The constructions of the aviation pack parachutes of G.E. Kotelnikov played a great role in promoting progress. Among their basic features and characteristics representing an improvement in construction is first of all the "autonomy" of the parachute. The parachute of Kotelnikov is not mounted on the flying machine(in contrast to the parachutes existing earlier). The pack, with the canopy placed in it, is fastened to the suspension system of the parachute and by means of it is attached to the aviator.

Among the advantageous characteristics of the construction of the parachute of Kotelnikov are the following:

-The action of the parachute both by the forced method of opening(the cord), and by manual opening;

-a decrease in the surface area of the canopy--41 square meters instead of 50 square meters;

-division of the shrouds into two groups by pairs, with the same number of them in each group and the fastening of them not at one point at the waist but at two free ends of the suspension system. This makes it possible for the parachutists to make turns before landing. Such a division and fastening of the shrouds also make it possible to execute side slipping, and, consequently, make it possible to control the parachute in the air during the descent.

-the connection of the shroud lines with the straps of the suspension system by means of a snap hook and a buckle, an arrangement which makes possible, if necessary, the unhooking of the canopy of the parachute.

-a special construction of the suspension system, consisting of shoulder, back, leg, and under reinforcing straps;

-an envelope-shaped pack, having cells for the folding of the shroud lines and closing device--a cable with 3 pins and a pull ring.

Hence, Kotelnikov created an entirely new type of aviation pack parachute, one making it possible to execute jumps with delay opening of the parachute.

G.E. Kotelnikov lived and worked in Leningrad. Here he was overtaken by the Great Patriotic War. Here he spent the hard months of the siege. In spite of advanced age Kotelnikov enlisted in the ranks of the fighters of a team of the M.P.V.O. (local AA defense) and took an active part in the heroic defense of the city of Lenin.

On 9 November 1936, the day of the 25th aniversary of the invention of the first aviation pack parachute in the world, the Central Council of Osoaviakhim of the USSR and the people of Moscow presented to the inventor the honorable chest insignia "Constructor". In 1944, Kotelnikov was awarded the Order of the Red Star for his fruitful inventive activity.

On 22 November 1944, G.E. Kotelnikov died in Moscow after a short illness. It is due to the untiring labors of G.E. Kotelnikov and his remarkable inventions that our country became the indisputable leader in the creation of the aviation pack parachute. Among Soviet parachute constructors Kotelnikov had many followers. The well known constructors N.A. Lobanov, I.N. Glushkov, N.A. Savitsky and many others continue to develop and perfect our home parachute technology.

THE PARACHUTE AS A DEVICE FOR RESCUE AND FOR SPORT

After the First World War the young Soviet republic received a wretched aviation heritage: some old airplanes in bad condition, worn out captured balloons, and together with these several dozen old Kotelnikov parachutes. But even these parachutes served their purpose with honor on the numerous fronts of the Civil War.

Among the Soviet balloonists there were enthusiasts striving to advertise the parachute by demonstration jumps. For example, in 1917, the balloonists N.

Anoshchenko, I. Nekliudov, S. Ostrov and others executed a number of demonstration jumps with parachutes from balloons.

In our country parachute construction grew and developed along with the growth of Soviet aviation. The year 1930 was marked by the manifestation of the first series of home parachutes, which were tested and found to be of good quality. In these parachutes one employed the principles of operation and construction of the main parts of the aviation pack parachute of Kotelnikov.

At first some aviators did not trust the rescue parachute. However, the many cases in which aviators and testers saved themselves with parachutes confirmed the great importance of the parachute as a reliable means for descending from an altitude to the ground.

M.M. Gromov, at the present time Hero of the Soviet Union, Col. General of aviation, executed on June 1927 the first forced jump. As a test pilot, testing a new airplane, he brought his plane into a corkscrew spin. After he had made several turns in the corkscrew spin, the aviator tried to bring the machine into a horizontal flight position, but his efforts were unsuccessful. The airplane would not respond to the controls and went into a flat corkscrew spin. A catastrophe was inevitable. The experimenter had to abandon the airplane and employ his parachute.

At an elevation of 600-700 meters, M.M. Gromov jumped from the airplane which was in a corkscrew spin, opened his parachute, and landed safely.

Soon after this experience of Gromov, the test pilots V. Pisarenko, B. Bukhgoltz, and others saved themselves in parachutes.

In a balloon accident the stratosphere pilots Professors A.A. Verigo and Yu. G. Prilutsky, the balloonist A. Krikun, the pilot A. Fomin and engineer N. Volkov saved themselves by means of a parachute.

A remarkable example of the employment of a rescue parachute was demonstrated by the Heroine of the Soviet Union Marina Raskova, who made, on 26 September 1938, upon the orders of the commander of the crew, V. Grizodubova, a daring jump with a parachute from the airplane "Rodina" in a thick Far East taiga.

Lastly, on 26 July 1930, at Voronezh, under the direction of aviator Ya. Moshkovsky and the first packer of parachutes, V. Baranov, now master of sports, a group of flying personnel executed 7 training jumps with a parachute from a multi-seater airplane. This marked the beginning of mass training and sport jumps. Hence,

the date 26 July 1930 is taken as the beginning of the development of mass parachute sport in our country.

The more popularity parachute sport acquired, the more pressing became the task of preparing cadres of instructors of parachute sport—directors and organizers of parachute jumps. The first group of instructors, who were the pioneers of Soviet parachutism, was trained in 1931. It included Ya. Moshkovsky, V. Baranov, V. Aleksandrov, V. Berezkin, N. Evdokimov, V. Petrov, V. Olkhovik, and A. Fotseev.

On 9 July 1931, the woman parachutist V. Kuleshova(Epishova) made the first jump in the USSR from an airplane with a parachute of forced opening. On 19 August, Vera Fedorova and Lidia Chirkova made jumps from an airplane with a parachute of free hand action.

In this same year the instructors of parachute sport V. Berezkin and B. Petrov made the first jumps with a parachute at night. In the cavalry maneuvers near Leningrad, directed by S.M. Budenny, one practiced for the first time an "air landing" consisting of participants of the assembly of parachutist instructors.

Towards the end of 1931, one executed in the USSR more than 600 training and demonstration jumps with a parachute. On the basis of the experience gained, one determined the basic rules and methods of training for jumping and the methods of executing them.

In a practical manner one solved a number of important questions: the selection of the type of airplane for the making of the practice training and sport jumps with a parachute, the determination of the most suitable height and speed of flight of the airplane for the making of the jump; the working out of rules for the employment of the reserve parachutes; the determination of the meteorological conditions under which one can safely execute training jumps etc.

In 1932, in Evpatoria one held a second special assembly for the training of instructors. At this assembly one made for the first time jumps with delayed opening of the parachute, jumps from a horizontal turn and group jumps on dry land, on water(in the sea). At this assembly one conducted the first competitions in parachute sport for instructors of the Military Air Forces of the Soviet Army. 25X1

At this same place on 22 May, Nikolai Evdokimov made from a height of 1200 meters the first jump with delayed opening of the parachute; he descended 600 m with an unopened parachute. This result was the first all-union record in jumps with

delayed opening of the parachute.

The first All-Union record for a parachute high jump without oxygen equipment was made by V. Petrov on 18 August 1932, who left the airplane at a height of 5200 meters.

S.Afanasev, on 29 September 1932, set a new jump record with delayed opening of the parachute. Leaving the airplane at a height of 2000 meters, he fell freely, without opening his parachute 1600 meters in 33.5 seconds. This was a world record(the recording of aviation records is done in the USSR by the V.P. Chkalov. Central Aeroclub of the Dosaaf of the USSR. The confirmation of the world record is done by the International Air Federation.(FAI). The scale(setka) of parachute records was introduced by the FAI in 1951 and the FAI did not begin to record the achievements in parachute sport until the end of 1952.

In 1932 a total of more than 2000 parachute jumps were made in the USSR.

PARACHUTE SPORT IN THE USSR

The Soviet Union is the homeland of mass parachute sport.

Parachute sport developed at a fast rate in the USSR' acquiring the character of a true mass and national form of sport.

"In the world there are many different heroic people, capable of exploits. There are such people even in the bourgeois countries, beyond the ocean and on the European continent. But in these countries there are not tens, hundreds, and thousands of people who love parachutism as their own and indispensable business. There are no such people as ours who love this sport and who master it first of all because they understand its significance for the cause of the freedom of their Fatherland, for the protection of the building of Socialism". Thus K.E. Voroshilov, in his address to the First All-Union Conference of Stakhanovites characterized the great defensive importance of parachutism in our country.

In 1933, Soviet parachute sport received its organizational form. The direction of it was assigned to the Central Committee of the Leninist Young Communists League and the Central Council of the Osoaviakhim of the USSR.

In 1933 there was organized in Moscow a superior parachute school, which trained a large number of instructors, sport masters and world record holders. In this same year one started to organize parachute -glider-stations at the aeroclubs of Osoaviakhim. In the towns, villages, parks and rest places, on collective farms and

state farms, one constructed parachute towers. A jump from a parachute was a part of the requirements for GTO second class(readiness for labor and defense).

Parachute work won solid support among the workers and the youth of the collective farms.

In the course of the year 1933, Soviet parachute sportsmen mastered the technique of the mass execution of various kinds of parachute jumps. They made jumps under winter conditions, at night, over water, in strong wind; they mastered jumps from balloons and dirigibles, from airplanes executing various figures of advanced pilotage and from various points of the airplane.

Towards the end of 1933 Soviet parachute sportsmen, both men and women, mastered and firmly held the world records in jumps with delayed opening of the parachute.

On 15 February 1933, the parachutist N. Zvorygin made a record jump with delayed opening of the parachute. Leaving the airplane at a height of 2500 meters, he dropped without opening the parachute, for 41 seconds. During this time N.Zvorygin dropped 2200 meters, which was a new world record.

Jumps with delayed opening of the parachute began to attract the attention of many Soviet parachutists, striving to master them in competition. P. Evedokimov achieved great successes in this field. On 21 August he made a jump from an altitude of 6920 meters and dropped with an unopened parachute for 115 seconds, descending in this time 6440 meters. This achievement of Evdokimov is also remarkable because he jumped from such a great height without oxygen equipment.

On 10 October the parachutist V. Kvseev jumped with oxygen equipment with delayed opening of the parachute from a height of 7200 meters. He descended in a free fall for 132.5 seconds, dropping during this time 7050 meters.

Parachute jumps were made for the first time from balloons and dirigibles. They were successfully mastered by N.Evdokimov, S.Shchukin, F. Bolosukhin and K. Kaitsanov.

Jumps were made from airplanes executing turns, dives, spirals, and corkscrew spins.

On 12 August P. Belashev executed a jump from an airplane from a height of 30 meters.

Beginning with 1933 it became a tradition on the Day of the Air Force of the USSR to demonstrate also our achievements in the field of parachute sport. For example, on 18 August 1933, at the first aviation celebration in Moscow, at Tushinsky

airdrome, 62 parachute sportsmen trained by Osoaviakhim in the aeroclubs without leaving their regular work, executed a group jump.

In 1934 we won 3 brilliant victories. N.Evdokimov executed, on 17 July, a jump with delayed opening of the parachute from a height of 8100 meters. This time the daring sportsmen dropped, without opening the parachute, 142 seconds and descended in a free fall 7900 meters.

The Moscow woman parachutist Zoya Rusheva, on 11 August, made a jump with delayed opening of the parachute, achieving an outstanding success. Leaving the airplane at a height of 2700 meters, she descended 2500 meters without opening the parachute. Two days later, on 13 August, the parachutists Nina Kamneva executed a jump from a height of 3000 meters. She descended for 58 seconds without opening her parachute and during this time she covered a distance of 2700 meters.

In 1934, there came into the ranks of parachutists a large detachment of well-trained instructors who had completed the Superior parachute school of the Osoaviakhim. The title of instructor of parachute sport was first awarded to women: O. Yakovleva, L. Berlin, T. Ivanova, N. Kamnava, L. Savchenko and others.

The newspaper, "Red Star" wrote the following on 21st August 1934:

"Three and a half years ago it was a question only of individual parachutists, but today we have hundreds and thousands. Many have made more than 100 jumps. K. Kaitanov made 113 jumps; B. Petrov made 106 jumps, and these were followed by A. Lukin, 104; V. Alexandrov, 103; V. Torlov, 103; Ya. Moshkovsky, 101; N. Polezhai, 100".

"Many parachutists left the airplane on a U-turn, on a half roll, in a corkscrew spin. There were delayed jumps and jumps at night and the parachute art developed more and more".

"Thousands and tens of thousands of parachutists unfurled their parachutes on Aviation Day in the blue skies and showed the world with pride the successes of our country and its combat power".

In 1934, an exceptionally daring experiment jump with a parachute from a glider was executed by S. Anokhin, now Hero of the Soviet Union, laureate of the Stalin prize, honorable master of sport.

It was necessary to test the glider in the air for its stability. In a steep dive the glider developed the limit velocity for its construction and at the moment

of overloading it broke up in the air. Sergei Saphin, leaving the glider, made a jump with delayed opening of the parachute in order to get away from the falling debris of the glider and then opened his parachute and landed successfully.

In 1934, on the basis of the decision of the Central Council of the Osoaviakhin one introduced the honorable sport title of "Master of Parachute Sport of the USSR." This title was awarded for the first time in this same year to a group of outstanding sportsmen--pioneers of parachute sport: Ya. Moshkovsky, N. Evdokimov, V. Evseev, S. Afanasyev, B. Petrov, A. Fotoev, N. Ostryakov, A. Lukin, E. Balashev, N. Kamnev and others.

In the year 1935 Soviet parachutists achieved a real triumph. They finally won and consolidated a majority of the world records, exceeding by a great deal the sport-technical achievements of foreign professional parachutists.

On 4 March 1935 K. Belyanov made a high parachute jump without oxygen equipment, leaving the airplane at a height of 6800 meters.

One of the first Soviet parachutists, Vera Fedorov, on 31 March executed an outstanding high jump without oxygen equipment from a height of 6356.5 meters. She descended in the parachute from this height for 22 minutes. During this time V. Fedorova was carried by air currents to a distance of 25 km from the place of the jump.

N. Lisischkin, on 6 June, made a high night jump without oxygen equipment leaving the airplane at a height of 6500 meters.

V. Kozul on 8 June executed a day high jump without oxygen apparatus, leaving the airplane at a height of 7445 meters.

In this same year V. Kharkhonov, for experimental purposes, made a jump from a height of 3000 meters, using special wings. Similar experiments were repeated afterwards by the Soviet parachutists Sanfirov, Loptev, and also by Pavlov-Silivansk jointly with Rovnin.

The Soviet sport parachutists passed from individual record jumps to group jumps. On 17 June, 6 girls, N. Nebushkina, L. Kartseva, S. Elokhina, M. Malinovskaya, A. Nikolaeva under the direction of S. Yakovleva, executed a group jump with a parachute from a height of 7035 meters, without oxygen equipment.

On 23 June the sportsman parachutist Nabi Amintaev, who had already become famous by daring jumps, executed a record jump without oxygen equipment from a

height of 7612 meters, and on 25 July he made a jump with oxygen equipment from a height of 8126 meters.

The Leningrad woman sport parachutist Tamara Katalova made a new record on 30 July, executing a parachute jump without oxygen equipment from a height of 7750 meters.

The students of the Moscow Institute of Physical Culture and Sport, Anna Shishmareva and Galina Pyasetskaya, now meritorious mistress of sports, set on 2 August an outstanding record for a high jump without oxygen equipment: they left the airplane at a height of 7923 meters and immediately opened the parachutes.

On 12 August master of parachute sport of the Soviet Union, Nikolai Ostryakov, subsequently Hero of the Soviet Union, Major General of Aviation, made a jump with a parachute on the Dynamo Stadium in Kiev from a height of 80 meters, repeating the record of P. Balashev.

The brilliant achievements of Soviet parachutists, their services in the field of the mass development of parachute sport, were recognized many times by government rewards.

6 May 1935 was a remarkable day for all parachute sportsmen of the Soviet Union. On this day one published the decision of the Central Executive Committee of the USSR for awarding to parachute sportsmen, for outstanding services in the development of parachute sport, orders of the Soviet Union. Among those receiving the award were V. Alexandrov, P. Balashev, N. Evdokimov, V. Evseev, N. Kamneva, K. Kaitanov, A. Lukin, Ya. Moshkovsky, B. Petrov, L. Savchenko, P. Strozhenko, V. Fedorova, V. Chevkorin and O. Yakovleva.

S. Anokhin, S. Afanasyev, V. Kozulya, and Sukhomlin, K. Khalebaev and others were awarded diplomas of the Central Executive Committee of the USSR and valuable gifts.

Still another group of parachutist sportsmen were soon awarded orders of the USSR, namely, A. Foteev, N. Amintaev, V. Kharakhonov, N. Babushin, N. Ostriakov, T. Kutalova, A. Shishmareva, G. Pyasetskaya and others.

On 12 July 1935, the directors of the Party and the government, with I. V. Stalin at the head, visited the V.P. Chkalov Central Aero Club of the USSR. On this day the aviation sportsmen demonstrated their achievements for the dear guests. Marshal of the Soviet Union K.E. Voroshilov, speaking to the sportsmen, gave a high

appraisal of their successes in aviation sport and expressed to them warm gratitude in the name of the Central Committee of the Communist Party and the Soviet Government.

In 1935, on the basis of a decision of the Central Committee of the Lenin Young Communists League, the Central Council of Osoaviakhim and the All Union Central Council of Trade Unions there was held in Moscow in the period on 6-15 August the first All-Union gathering of parachute sportsmen, which was the first All-Union contest in parachute sport. The program of the contest was broad and varied. The participants compted in jumps for precision in landing, in precision of delayed opening of the parachute, and conducted sport parachute games with the execution of tactical missions not only in the daytime but also at night.

The best sport results were demonstrated by the team of the V.P. Chkalov Central Aeroclub of the USSR made up of Stepanov(Captain), Gladkov, Shchukin, Polosukhin, Ivanov and Rastorguev(parachute packer). They took first place in the general team championship, and also won 3 of the first places in the personal contests for precision in landing, for precision in delayed opening of the parachute and in the sport parachute game.

The second place was taken by the first team of the city of Moscow made up of Romaslovsky(Captain), Sanfirov, Malinovsky, Vladimirsky and Zobnenko(parachute packer).

The team of the Zhukov Military Air Academy made up of Amintae (Captain), Baikalov, Stepanchikov, Shpakov, Timchenko and Sokolov(parachute packer) won third place.

In the sport parachute game the first place was won by the team of the V.P. Chkalov Central Aeroclub of the USSR: the second place was won by the team of the Zhukov Military Air Academy and the third was won by the team of the Kiev Oblast, made up of Fedorovsky(Captain), Gevrish, Zavalin, Orlitska, and Mikhilinkov (parachute packer).

In the individual championship among the masters of parachute sport, the best sport technical results in the sport parachute game at night were obtained by master of parachute sport S.Afanasyev, who took first place. On the basis of precision in calculating landing at night, first place was won by master of

parachute sport Sanfirov.

On the day of the ceremonial closing of the first All-Union Meet of parachute sportsmen(15 August) one announced the decision of the Presidium of the Central Council of Osoaviakhim of the USSR for the awarding of the titles of "Master of Parachute Sport of the USSR" to N. Amintaev and S. Efimov. The title of the best packer in these contests was won by the packer Sokolov of the N.E. Zhukov crew of the Military Air Academy.

In these contests there participated 21 teams from the Krais, Oblasts and Republics of the Soviet Union, in the composition of which there were 143 parachute sportsmen, including 12 masters of parachute sport of the USSR. In the course of the contest one made 785 parachute jumps, 46 of these being group jumps, 29 night jumps, and 258 jumps for precision of landing and for precision in delayed opening of the parachute.

The first All-Union Meet(contest) of parachute sportsmen marked the beginning of the work of the sport parachute detachments at the Aeroclubs of Osoaviakhim. Parachute sport began to take in additional thousands of young people, men and women, ardent patriots of our great country.

The parachute sportsmen of the Soviet Union, in the course of the first five years, won all of the world records in parachute sport.

In 1935, during the fall training exercises of the Kiev military district, 1200 men were dropped by parachute, with weapons and a full supply of ammunition. After landing the soldier parachutists started an attack against an imaginary enemy and successfully executed the mission assigned to them.

During the same year, in the fall training exercises, in one of the military districts, one released 1800 men by parachute.

On 28 June 1937, K. Kaitanov made a high jump leaving the airplane at a height of 9800 meters and on 24 August he beat his own record by making a jump from a height of 11,037.

On 20 October of the same year, master of parachute sport of the USSR, Nabi Amintaev made a parachute jump from a height of 10,080 meters.

From 15 May to 11 June 1939, there was held in the North Caucasus an all-army training assembly(for refresher training) of parachute instructors. In the assembly there was participation by master of parachute sport A. Zigaev, V. Romaniuk, N. Gladkov, V. Medov, T. Storozhenko, S. Syurtsov, N. Chernyshev and others.

At the assembly one executed individual and group high jumps.

A matter of great importance was the jumps of 22 parachutists on 22 May from a height of 4000 meters without oxygen equipment. Following this, on 25 May, 23 parachutists made a jump from a height of 5210 meters without oxygen equipment.

At this meet, on 1 June, 25 parachutists made jumps from a height of 5000 meters without oxygen equipment, and on 3 June a group of parachutists of the same number made jumps from a height of 7400 meters employing oxygen apparatus.

Before the close of the meet on 5 June, 27 parachutists made parachute jumps at night from a height of 5200 meters, and, on 9 June, 7 parachutists, namely, A. Zigae, V. Kozulya, A. Lukin, V. Romaniuk, [illegible]ublerov, A. Fediunin, and N. Tsyylev, executed group jumps from an altitude of 8200 meters. All the jumps, both those from great heights and also those made from planes flying at high speeds, were executed with great skill. The jumps were made exclusively with Russian made parachutes and with Russian semi-automatic parachutes devices, all of which worked perfectly.

The All-Army assembly of parachute instructors in the North Caucasus served as a stimulus for further development of mass parachute sport and the perfection of the skill of the sportsmen.

Soon after the meet, on 27 July, the parachutists K. Kaitanov, N. Nureev, and A. Barkov made a group jump from a height of 8,750 meters.

On 18 May 1940, for the first time in the USSR, a large group of parachutists consisting of Bulanov, Velkovsky, Desyatnikov, Lakonty, Kostev, Letunov, Mikhailov, Orlov, Patrakov, Popov, Romaniuk, Soloviyenko, Storchienko, Syrtsov, Kharakhonov and Chirkov executed a day group jump with delayed opening of the parachute. Leaving the airplane at a height of [illegible], the parachutists dropped 7400 meters without opening the parachute. On the following night this same group made a jump with delayed opening of the parachute from a height of 6242 meters. The parachutists dropped 4242 feet without opening the parachute.

On 20 May, masters of parachute sport of the USSR, V. Romaniuk, V. Kharakhonov, N. Patrakov and S. Syrtsov made a group day jump with delayed opening of the parachute. They dropped, from a height of 9648 meters, for a distance of 8848 meters without opening the parachute.

The master of parachute sport of the USSR, K. Kostev, made a jump at night

on 24 July, without oxygen equipment, from a height of 7750 meters, doing better than the holder of the high night jump record holder M. Lisichkin.

On this same day, the master of parachute sport of the USSR, V. Kharakhonov, executed a remarkable jump with delayed opening of the parachute. He left the airplane at a height of 13025 meters and dropped 11755 meters without opening the parachute.

The second All-Union contest of Parachute [illegible], dedicated to the 10th Anniversary of mass Soviet [illegible] parachutists, opened on 8 July 1940 on the air drome of the V.P. Chkalov Central Aeroclub of the [illegible] town of Tushino). In the program of events there were jumps for precision in jumping without parachute opening, and a sport game, a group jump with subsequent movement in a given direction and fire from a small caliber rifle. In the contests the leading place was won by the first team of the Ukraine SSR, the second, by the team of the Georgian SSR; and the third, by the second team of the Ukrainian SSR.

From the years of the Great Patriotic War, Soviet parachutists have many glorious combat achievements to their credit. The rescue parachute saved the lives of many combat aviators who daringly struck the enemy employing such daring maneuvers as the "battering ram".

Our home parachute technology also played a great role in the supplying of the partisans with armament, ammunition, [illegible], food, literature, and other cargoes.

The present day parachute is used very extensively in various branches of the national economy of our great country. It renders irreplaceable service to various expeditions, especially under those conditions when the airplane is the only means of transport that can deliver to the members of the expedition the food products, warm clothing, and other things [illegible]. In mountains, forests, localities, in the Far North, on the ice packs, in the areas of flood, airplanes often cannot make a landing. Then the parachute comes to the rescue, because/it with one can drop from the airplane the required load, man, etc and render the necessary assistance.

At the beginning of 1935, in the area of Astrakhan, a hurricane wind tore loose from the banks a large block of ice on which there was a group of fishermen. The block of ice was carried into the Caspian [illegible]. The fishermen suffered great

hardships. In spite of the unfavorable weather conditions some daring aviators, having flown out in airplanes in search for the fishermen, discovered the block in the open sea. From the airplane they dropped by parachute to the fishermen the food, fresh water, and warm clothing which they needed and after some time they were taken from the ice block.

The present day parachute is also employed with great success in medical aviation. The surgeon parachutists have saved the lives of many Arctic workers living in remote regions difficult of access.

The parachute is of inestimable importance in the protection of our forest massifs. Parachutist firefighters execute daring jumps, under the difficult conditions prevailing in the taiga, for extinguishing forest fires. By means of cargo parachutes one drops to them from airplanes the firefighting equipment, chemicals and other fire extinguishing means, food and other loads.

The great work the parachutists carry out during the time of the preparation for the election to the councils is well known. In particularly remote points of the country we use cargo parachutes to drop special literature from airplanes. Parachute jumps are executed by sportsmen "agitators" (propagandists) who conduct mass educational work among the population.

SOVIET PARACHUTE CONSTRUCTION

The Communist Party and the Soviet government have always devoted and are still devoting great attention to the development of parachutism. As early as 1928, we started to train specialists in construction in order to create a home parachute industry and parachute technology. After the experimental investigations and tests of models of aviation parachutes of different kinds and shapes were carried out by the Scientific Research Institute of the air forces of the Red Army, there was general approval of the basic principles of the aviation pack parachute for free action designed by the collective of S.P. Kotelnikov.

At the same time, we set before the industry of the USSR the task of creating on a mass scale a reliable home parachute, working without fail under any conditions and speed of flight of the airplane.

The laboratory, the head of which was Eng. M.A. Savitsky, successfully carried out the development of new constructions and the preparation of Russian parachutes. Here, the young specialists, beginners in parachute construction,

investigated in detail the materials, and studied the technology of production and manufacture of the separate parts of the present day parachute.

In April 1930, the laboratory manufactured the first rescue parachute constructed of home materials and meeting the requirement of the flight of present day airplanes. The manufacture of parachutes was being expanded. In this field we trained work cadres, organized collectives of constructors and experimenters.

Beginning with 1932, we started to manufacture other kinds of parachutes, in addition to rescue parachutes. In quality and reliability Soviet parachutes have excelled foreign parachutes.

Scientific research was crowned with good results. The constructor N.A. Lebanov, [illegible], at the present time candidate for technical sciences, proposed a flat square shaped parachute canopy with truncated corners, forming four canals for the exit of the air, which, in combination with the general shape, makes possible a stable descent of the parachutist in the air.

In February 1934, we held the first conference to deal with the quality of home parachutes, a conference during which tests were made. One of the first to test in the air the square canopy parachute was leader of parachute sport of the USSR, N.A. Ostryakov. The test showed the new model of parachute to be of excellent quality and industry began to manufacture them on a mass scale.

Simultaneously with the growth of the production-technical base of parachute construction, we also developed extensive scientific-research and experimental construction work in the field of the improvement of parachute technology. We also studied new kinds of fabrics and materials for parachutes. We worked out new and improved models of silk, semi-silk and cotton fabrics of the frame type.

Soviet parachute construction kept pace at all times with the general development of aviation. It followed constantly the increase in the speed of airplanes and worked in order to develop a new parachute technology meeting the requirements of the increased speed and loads.

In 1939, the Soviet balloonists, A. Fedin, N. Volkov and A. Erikun conducted tests of the first stratostat-parachute in the world, the SSR-VR-60, created by engineer, T. Kulichenko. The stratostat-parachute rose on 12 October 1939 to a height of 16810 meters. At this great height the daring balloonists made a photograph, took a sample of the air, and began to descend. The enormous balloon

net of the stratostat-parachute, having a cubic capacity of 19,600 cubic meters, after descending to a height of 9000 meters, was converted into an enormous parachute.

The purpose of the flight of the first stratostat-parachute in the world, the SSH-VR-60, was achieved. The production of our home parachute industry met most successfully all of the tests.

Mass jumps with a parachute, parachute rockets, speeds, high jumps and jumps with delayed opening of the parachute were executed only with parachutes which had been made by Soviet constructors, and fastened from home materials and in home factories.

In the years of the Great Patriotic War the parachute industry put forth a special effort. It provided the Soviet army with rescue, cargo, and special parachutes. Along with the most varied kinds of parachutes, the soldier parachutist and aviators were also provided with excellent parachutes of semi-automatic construction of the brothers Voronin & Lee laureated with the Stalin prize, and engineer L. Savvichev, also a laureate of the Stalin prize.

These parachutes insured the technical safety of the parachute jump both under combat conditions and in the execution of sport and record jumps.

The Soviet Government valued very highly the work of the parachute constructors. As early as 1940, the best parachute constructors were awarded orders and medals of the Soviet Union, and master of sport N.A. Lobanov was awarded the Stalin prize.

In January 1944, for exemplary carrying out of the tasks of the government, a number of parachute constructors were given government rewards.

SOVIET PARACHUTISM IN THE POST-WAR PERIOD

The post war years were characterized by an extensive employment of aviation in the national economy of the country. Special airplanes were employed by agriculture, forestry and the fishing industry. These airplanes dropped cargoes and conducted prospecting work for useful minerals. Not only were airplanes used extensively for peacetime purposes but also parachutes. At the same time there was a further development of parachute sport. Soviet parachutists continued to make records.

After the close of the Great Patriotic War the well known master of parachute

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sport of the USSR, Nabi Amintaev, on 11 August 1945 executed the first outstanding jump with delayed opening of the parachute from the [illegible] of a substratostat from a height of 10,436 meters. He dropped for 150 seconds without opening the parachute and during this time covered a distance of [illegible],726 meters.

On 24 September of this same year, the [illegible] [illegible] man Vasily Romaniuk made a record jump with delayed opening of the parachute from a height of 13,108.5 meters. He fell without opening the parachute for 107 seconds, dropping during this time in a free fall 12,141.5 meters. This record was confirmed as an All-Union one.

The outstanding group jump from a height of [illegible],200 meters was made on 31 July 1947 by a group composed of V. Romaniuk, [illegible], [illegible] Fotkevich, N. Gladkov, P. Skorokhenko, I. Savkin, P. Tshchenko, and [illegible].

Following this record group jump, [illegible] on 8 August 1947, made a high jump from a height of 12,240 meters; [illegible], on [illegible] August of this same year, made a parachute jump from a height of 12,520 meters, and 3 days later, that is, on 13 August, V. Romaniuk made an outstanding parachute jump from a height of 13,400 meters approved as an All-Union record.

In the efforts to make world records in parachute sport, women took an active part. Elena Vladimirskaya, on [illegible] August 1947, executed a jump with delayed opening of the parachute from a height of [illegible] meters, falling with unopened parachute for 71 seconds. During this time she dropped 3720 meters. By her jump E. Vladimirskaya beat the record of [illegible] Kataeva ([illegible]).

A month later on 4 September, Vladimirskaya beat her own record, Leaving the airplane at a height of 5840 meters and dropped [illegible] meters without opening her parachute.

A group of parachutists made up of [illegible], [illegible] Torobov, [illegible] Nochevny, V. Ivanov and K. Erpichev executed a night jump [illegible] October 1948 from a height of 6680 meters without oxygen apparatus, setting an All-Union record for a high group night jump. On this same night, from a height of 6680 m, E. Vladimirskaya became the first woman in the [illegible] to execute an individual night high jump without oxygen apparatus.

In parachute jumps from planes flying at high speeds, master of sport A. Bystrov achieved remarkable success. On 13 November 19[illegible], he made a parachute jump from an

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airplane flying in horizontal flight.

From year to year Soviet parachute sportsmen have increased their skill and parachute sport has acquired a more and more mass character.

A group of parachute sportsmen, [illegible], K. Frolichev, V. Ivanov, V.V. Borosev, V. Krivy, and [illegible] made a night jump on 22 June 1949 from a height of 10,370 meters. At this same time, [illegible] Vladimirskaya made a night jump in a parachute leaving the airplane [illegible] height of 10370 meters.

These parachute jumps were confirmed by the [illegible] Commission of the V.P. Chkalov Central Aeroclub of the [illegible] sports and represented world achievements.

For the third time after the Great Patriotic War a [illegible] was held on 17-27 August 1949 in Tushino on the airfield of the V.P. Chkalov Central Aeroclub of the USSR: the Third All-Union contest in parachute sports. In the contests there was participation by 34 teams coming from many [illegible], oblasts and republics. Among the 132 participants in the contest there were 19 women.

In the contests there were [illegible] the events for the prizes named after persons and organizations: the team prize--challenge cup of the Central Committee of the Dosaav of the USSR; the G.F. Kotelnikov prize--for parachute jumps in precision of landing and the V.P. Chkalov prize of the Central Aeroclub of the USSR--for jumps in precision of delayed opening of the parachute.

As a result of the contests the challenge cup of the Central Committee of the Dosaav of the USSR and the diploma of the first degree for general team championship was won by the second team of the V.P. Chkalov Central Aeroclub of the USSR consisting of V. Ivanov, A. Kalinin, and I. Kogosin.

The first place for precision of landing and the G.F. Kotelnikov prize was won by the sportsmen of the Ryazan Aeroclub V. Volkov. Among the women in this form of contest the record was made by by [illegible] Zaitseva(Kozlova).

On the final day of the contests, 27 August, a group of women consisting of Elena Vladimirskaya, Galina Pyaskovskaya, and Nadezhda Gulyaeva, now honorable mistresses of sports, made a day group jump with delayed opening of the parachute. The parachutists left the airplane at a height of 6200 meters and dropped for 95.7 seconds without opening the parachute, descending during this time 5419 meters.

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In August 1950, the aviation-sport public celebrated the 20th anniversary of mass parachute sport and parachute construction in the USSR. On this date one timed the opening of the 4th All-Union contest of parachutists which was held on the airdrome V.P. Chkalov Central Aeroclub of the USSR in the town of Tushino.

The contest was attended by 80 of the best parachute sportsmen, representatives of various republics and towns, including 18 women. Among the participants in the contest there were parachutists having to their credit from 20 to 1600 parachute jumps. Six men had from 1000 to 1600 jumps, [illegible] had from 500 to 1000, 37 had from 100 to 500, 10 had from 50 to 100, and [illegible] had from 20 to 50.

Two honored masters of sport, 19 masters of sport, and 59 qualified sportsmen participated in the contest.

In the contest the winners were [illegible] (Shatkov), now honored master of sports, who won the title "Absolute Champion of the USSR in Parachute Sport for the Year 1950", among the men, and the sportswoman of the V.P. Chkalov Central Aeroclub of the USSR L. Volkova, among the women who won the title "Absolute Champion of the USSR in Parachute Sport for the year 1950" and the title "Champion of the USSR for Parachute Sport for the Year 1950" for precision in the calculation of landing. The title "Champion of the USSR in Parachute Sports for the Year 1950" was won by Aleksei Kalinin(Moscow)--for precision in landing, by Aleksandr Sokolovsky--for precision in delayed opening of the parachute, and by Aleksandra Gusarova(woman) --for protection in delayed opening of the parachute.

485 parachute jumps were made in the contest.

Soon after the close of the 4th All-Union Contest, on 29 September, a group of women consisting of E. Vladimirskaya, A. [illegible], [illegible]resentskaya, V. Seliverstova, I. Konyaeva and A. Sultanova made group jump [illegible] from a height of 5600 meters with delayed opening of the parachute for a drop of 5335.3 meters.

On the second day, a group of parachutists consisting of A. Vasilenok, V. Vologzhanina, A. Gusarova, M. [illegible] and [illegible]. Seliverstova made a group high jump at night with a parachute from a height of [illegible]00 meters. On 1 October, a group of parachute sportsmen (E. Naumenko, V. Mariukhin, A. Kalinin, A. Popov and P. Kosinov) made a day group jump with delayed opening of the parachute for 5480 meters. The jump was made from a height of 6500 meters. This same group, on the next day, made a night group jump from a height of 6400 meters with delayed opening of the parachute for 4660 meters.

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On 2 October E. Vladimirskaye made a night jump from a height of 6000 meters with delayed opening of the perachute for 4820 meters, and on 5 October the master of sport A. Kalinin made a night jump from a height of 6300 meters, with delayed opening of the parachute for 5100 meters.

A night jump of exceptional difficulty with delayed opening of the parachute was made on 25 July 1951 by master of sports I. Storchenko. Leaving the airplane at a height of 7440 meters, he dropped 6500 meters without opening the parachute.

On this same night a group of parachutists consisting of I. Orlitska, A. Sultsnova, O. Sushchinska and K. Kvinto [illegible] for a high night group jump, leaving the airplane at a height [illegible] meters.

On 27 July the woman parachutist of the Kiev [illegible], V. Selivorstova made a jump from a height of 7140 meters with delayed opening of the parachute, being in a free fall for a drop of 6180 meters.

On the airdrome of the Central Aeroclub in Kiev, in August 1951, one held the first All-Union Contest of parachutists for the Championship of the Dosaav of the USSR. 74 sportsmen took part in the contest. The title of "Absolute Champion of the Dosaav of the USSR in parachute sport for 1951" and the title of "Champion of the Dosaav of the USSR for 1951 for Precision of Landing" was won among the men by E. Naumenko(Kiev). The title of "Absolute Champion of the Dosaav of the USSR in Parachute Sport for 1951" and the title "Champion of the Dosaav of the USSR for 1951 for Precision in Landing" was won among the women by V. Grekhova(Ufa).

The title "Champion of the Dosaav of the USSR in Parachute Sport for 1951 for Precision in delayed opening of the parachutes" was won among the women by the woman parachutists of the Kiev Aeroclub I. Orlitskaya.

In the contests one made 400 parachute jumps.

The 5th All-Union contest of parachutists opened on 13 August 1951 at the airdrome of the V.P. Chkalov Central Aeroclub of the USSR in the town of Tushino. In the contest there participated 9 male and 4 female teams consisting of 51 persons. Among the participants in the contest there were four honored masters of sports, 24 masters of sport and 23 qualified sportsmen.

In the contests one executed 365 parachute jumps.

In the multi-events(or contests) team championship (among the men) the chief place was won again by the team of the V.P. Chkalov Central Aeroclub of the USSR

composed of V. Ivanov (captain), A. Kalinin, K. Lushnikov, A. Popov and the aviator S. Korobov. It made 372.06 points out of 540 possible, winning for itself the challenge cup of the Dosaaf of the USSR.

Among the women the first place in the all-events was also won by a team of the V.P. Chkalov Central Aeroclub of the USSR, team consisting of E. Vladimirskaya, (Captain), M. Skovorodneva, [illegible], L. Kozyaeva and the flier M. Loginova, which won 323.64 points. It was awarded the challenge cup of the Dosaaf of the USSR.

The title "Absolute Champion of the USSR in aeronautical sport for 1951" among the men was one won by master of sport [illegible] and among the women by N. Skovorodneva(Moscow).

The title "Champion of the USSR in parachute sports for 1951" was won by master of parachute sport A. Petrov(Soviet Army) and honorable master of sport N. Sadonova(Moscow)--for precision in landing, master of sport A. Kalinin(Soviet Army) and sportswoman M. Mikitina(Moscow)--for precision in delayed opening of the parachute.

For the best indexes in the combined exercise, parachutist, A. Bushnev (Ministry of the Lynest Industry of the USSR), who took first place, was awarded the Nebi Aminbaev prize of master of parachute sport of the USSR.

Of the 25 places, 20 were taken by sportsmen of the aeroclubs of the Dosaaf.

The 5th All-Union contest showed that the skill of sportsmen-parachutists was increasing constantly and that Soviet parachute sport had reached levels that one could not dream of in the case of the professional parachutists of any capitalist country.

In 1951, one set the first records for precision in landing from different heights.

Master of sport V. Ivanov(Moscow), [illegible], set the first All-Union record for precision in landing from a height of [illegible]. The average result of the two jumps was 27.25 meters deviation from the center of the circle. On the second day, 10 August, the master of sport N. Nikolenko(Kiev) beat the record of V. Ivanov, setting a new record for precision in landing from a height of 600 meters. He landed 16.53 meters from the center of the circle.

On 1 October the group of sportsmen of the Chkalov Central Aeroclub of the USSR, composed of V. Ivanov, A. Kalinin and S. Korobov set the first record of a group jump for precision of landing from a height of 600 meters, showing an average result

of deviation from the center of the circle of 42.10 meters.

Soviet parachute sportsmen mastered more and more the parachute jump technique with high speeds of flight from present day flying machines. For example, in 1951, the parachute sportsmen P. Dolgov and leader on Yu. Gorbaev and V. Kochetkov exceeded by a great deal the jump record at a high speed of flight, held previously by master of sport A. Bystrov.

On the airdrome of the Chkalov Aviodtib of the USSR on 7 March 1952, one established new records for precision in the execution of landing. The masters of sport P. Storchienko, D. Zhuravlev and V. [illegible] abandoned the airplane at a height of 500 meters and landed in the record circle showing a result of 32. 88 m, the average deviation from the center of the circle.

The parachute sportsmen V. Antonov, N. Gorelik and I. Fedchishin, executing parachute jumps for precision of landing from a height of 1000 meters, landed in the record circle, showing a result of 54.25 m—average deviation from the center of the circle.

The other group consisting of M. Markelov, N. Rachkov and N. Klimov on this same day beat this record and established a new one of 70.55 m.

The group of Simferopol parachute sportsmen, S. Vitalin, V. Sochnev and A. Toukonog, did still better on 11 May in a group jump for precision of landing from a height of 1000 meters. The parachutists landed at 46.53 m from the center of the circle.

The honorary masters of sport V. Koxaniuk, P. Vladkov and Master of sport N. Zhukov, on 15 July, improved the record for precision of landing from a height of 600 meters, landing 30.99 m from the center of the circle.

In August 1952, on one of the airdromes near Kharkov, one held the 6th All-Union contests for the championship of the USSR in parachute sports.

The program of contests, in which there was participation by 13 teams, was, in comparison with the preceding, more extensive and complicated. The contests were carried out under exceptionally keen sport struggle.

The honorary sports title "Absolute Champion of the USSR in Parachute Sport for 1952" in the men class was won by master of sport E. Mavrenko (Central Aeroclub of the Dosaaf of the USSR-Kiev). Among the women the title "Absolute champion of the USSR for 1952" was won by the young sportswoman first class M. Shveinova.

(Central Aeroclub of the Ukraine SSR-Kiev).

The title "Champion of the USSR in parachute sport for 1952" was won by the following: Master of sport N. Klimov(Stalingrad) and master of sport V. Seliverstova (Omsk)--for precision in landing from a height of 600 meters; master of sport E. Naumenko(Kiev) and the young sportswoman Ye. Chernyshova (Rostov on Don)--for precision in landing from a height of 1000 meters; master of sport F. Neimark (Moscow) and honorary master of sport E. Vladimirskaya(Moscow) --for combined jump; master of sport P. Kosinov (Dnepropetrovsk) and young sportswoman I. Lavrova (Yaroslavl) --for jump with precise delay opening of the parachute; master of sport F. Neimark(Moscow)--for precision in landing at night.

Excellent records in competition were made by the teams of the aeroclubs of the Dosaaf.

The group jump for precision of landing from a height of 1000 meters was of great sport interest.

Among the men the best records were made by the first team of the Dosaaf of the USSR made up of masters of sport P. Storchienko(captain), P. Kosinov, K. Lushnikov and I. Fedchishin. The average distance of landing from the center of the circle of the 3 participants of the group jump was 14.33 meters.

Among the women in this event the first place was won by the team of the Dosaaf of the USSR consisting of mistress of sport V. Seliverstova(captain), A. Šultanova, A. Mishustina and V. Eniutina, with a result of 39.33 meters--the average distance of the 3 participants from the center of the circle.

On the basis of the total of all the events among the men teams, the first place was won bythe Dosaaf team of Moscow, composed of masters of sport I. Kozlov(captain), E. Lebedkin, V. Pershin and F. Neimark(1087.4 points). The flier of the team was master of sport I. Iliukhin. The second place was won by the scratch team of the Dosaaf of the USSR consisting of masters of sport P. Storchienko (captain), K. Lushnikov, P. Kosinov, and I. Fedchishin(1083.35 points). The flier of the team was sportsman I. Damnich.

The team of the Dosaaf of the Ukraine, consisting of masters of sport N. Tkachenko (captain), E. Naumenko, and of sportsman P. Bannikov and S. Raginsky won third place. The aviator of the team was N. Kornienko.

Among the women teams, on the basis of the total of all the events, first place

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was won by the team of the Dosaaf of the Ukraine consisting of honorary mistress of sport A. Gusarova(Kolchugina) (captain), sportswoman [illegible] Karaeeva , N. Katasanova and L. Bespyata. The flier of the team was master of sport G. Martynenko. The second place was won by the second team of the Dosaaf of the USSR consisting of mistresses of sport M. Smirnova(captain), [illegible] [illegible]inova and I. Lavrova and the sportswoman Ye. Chernysheva. The flier of the team was F. Kolokolov. The third place was won by the first team of the Dosaaf [illegible] the USSR made up of mistresses of sport V. Seliverstova(captain), [illegible] and [illegible] A. Mishustima and V. Pniutina(flier–M. [illegible]).

In the course of the contests [illegible] new All-Union parachute records.

A new record in jumps for precision of landing from a height of 600 meters was made on 19 August by master of sport [illegible] ([illegible]alingrad). He landed 7.11 meters from the center of the circle(the average result of 2 jumps). S. Barinsky, executing a jump from a height of [illegible] meters, landed on 20 August 8.37 m from the center of the circle. On this same day a group of sportsmen made up of [illegible] Kosinov, P. Storchienko and I. Fedchishin made a jump from a height of 1000 meters and landed 15.06 meters from the center of the circle(the average distance of three participants), and a group of women made up of [illegible] Pniutina, A. Mishustina and V. Seliverstova landed at a distance of [illegible] m from the center of the circle. Ye. Chernysheva, executing a jump on 22 August from a height of 1000 meters, landed 26.85 meters from the center of the circle (the average distance as a result of 2 jumps).

The record day parachute jump was executed by mistress of sport A. Sultanova. On 10 September she left the airplane at a height of 8356 meters and fell, without opening the parachute, for [illegible] seconds, [illegible] during this time 7246 meters. The achievement of A. Sultanova in this form of parachute jump is an All-Union and world record.

On this same day a group of young sportswomen made up of V. Vologzhanina, A. Kasparova, N. Krushkina, [illegible] Pankevich and Ye. Chernysheva made a day group jump with delayed opening of the parachute. They left the airplane at a height of 7606 meters and dropped 6500 meters without opening the parachute, establishing an All-Union and world record.

A group of sportsmen-parachutists consisting of masters of sport I. Kozlov,

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V. Pershin and sportsmen Yu. Arkhangleesky and D. Usaty, on 10 September, established an All-Union and world record for a day group jump with delayed opening of the parachute. Abandoning the airplane at a height of 8516 meters they dropped 7476 meters without opening the parachute.

On 11 September a group consisting of the honored master of sport G. Pyasetsky, mistresses of sport L. Sultanova and N. Shveinova and sportswoman A. Mishustina made a new All-Union and world record of a night group jump with delayed opening of the parachute. Leaving the airplane at a height of 8216 meters they dropped 7050 meters without opening their parachute.

Master of sport [illegible] Shcherbinin, on the second day, made a new All-Union and world record for a night jump with delayed opening of the parachute. Leaving the airplane at a height of 10,870 meters, he fell 9726 meters without opening the parachute.

On this same night mistress of sport L. Seliverstova made the woman All-Union and world record jump with delayed opening of the parachute. She left the airplane at a height of 9416 meters and dropped 8326 meters in 150 seconds without opening the parachute.

On 12 September a group of [illegible] sportsmen consisting of V. Mariutkin, L. Maslennikov, I. Fedchishin and L. Prokhorchin, executing a group night parachute jump from a height of [illegible] meters, dropped without opening the parachute 8266.5 meters, establishing a new All-Union and world record.

The aviation sport commission of the V. P. Chkalov Central Aeroclub was notified by the International Aviation Federation(F.A.I.) of the approval of the new world records of the aforementioned achievements of the Soviet parachutists in jumps with delayed opening of the parachute and high jumps.

The Soviet parachutists, Yu. Arkhangelsky, V. Vologzhenina, A. Kasparov, I. Kozlov, V. Mariutkin, L. Maslennikova, A. Mishustina, I. Pankevich, V. Pershin, G. Pyasetskaya, V. Seliverstova, P. Storchienko, A. Sultanova, N. Trushkina, D. Usaty, I. Fedchishin, Ye. Chernyshova, N. Shveinova and N. Shcherbinin were the world record holders in parachute sport.

The All-Union record jump for precision of landing from a height of 1500 meters was made on 3 October by master of sport of the USSR G. Vitolin, showing a result of 85.51 meters(on the basis of the new record schedule this achievement

was no longer an All-Union record, because on the basis of the new requirements it was necessary to land from this height in a circle having a diameter of 150 meters.)

Eight days later, on 11 October, the parachutist sportsmen V. Zakharov, D. Mukhached and A. Storozhev, executing a group jump from a height of 600 meters, landed 18.17 meters from the center of the circle.

In 1953, some remarkable sport achievements were made by parachutist sportsmen in jumps for precision of landing. On 23 May, a group of parachute sportsmen consisting of V. Rakov, N. Shcherbinin and B. Shustrov, made a combined jump from a height of 600 meters, landing 14.40 meters from the center of the circle.

On 11 June, a group of parachute sportsmen, consisting of D. Aristov, N. Klimov and V. Mariutkin, executing a combined jump from a height of 1500 meters landing 17.33 meters(the average distance of 3 participants) from the center of the circle.

In 1953, some remarkable sport achievements were made by parachutist sportsmen in jumps for precision of landing. On 23 May, a group of parachute sportsmen consisting of V. Rakov, N. Shcherbinin and B. Shustrov, made a combined jump from a height of 1000 meters, landing 26.74 on from the center of the circle.

On 9 June, this same group, making a combined jump from a [illegible] height of 600 meters, landing 14.40 meters from the center of the circle.

On 11 June, a group of parachute sportsmen, consisting of D. Aristov, N. Klimov and V. Mariutkin, executing a combined jump from a height of 1500 meters landing 17.33 meters(the average distance of 3 participants) from the center of the circle.

On 12 June, P. Kosinov, P. Storchienko, and I. Fedchishin, making a jump from a height of 600 meters, landed 12.40 meters from the center of the circle.

On this same day a group of parachutist sportswomen consisting of A. Mishustina, G. Pyasetskaya and V. Saliverstova jumped from a height of 600 meters, landing 19.46 meters from the center of the circle.

On 16 June, V. Govenin, A. Popov and L. Fedin, jumping from a height of 1500 meters, landed 33.33 m from the center of the circle.

On 13 July, the parachutists sportsman K. Shaipov, jumping from a height of 1000 meters, landed with an average deviation from the center of the circle of 6.71 meters. On this same day the women parachutist L. Penkevich, jumping from a height of 600 meters, landed with an average deviation from the center of the circle of 21.55 m.

On 18 July, L. Pankevich, jumping from a height of 1000 meters, improved her achievement, landing with an average deviation from the center of the circle of 18.87 m.

In 1953, from 30 August to 10 September, one held in the Mordov ASSR the 7th All-Union Individual -Team contests in parachute sport for the championship of the USSR for 1953.

In these contests there was participation by 12 men and 6 women teams, in the make-up of which there were 70 participants; about half of the sportsmen and sportswomen participated for the first time in the events of the All-Union Championship for parachute sport.

In the sum total of the contests, the prize places for the separate events of the program were won by the following teams:

In jumps for precision of landing from a height of 600 meters first place was held by the team of the Dosaf- L, made up of Pr. Zhornik(captain), D. Aristov, M. Breikin and V. Mariutkin, winning 41.87 record points out of 75 possible.

Among the women teams, first place was won by the team of Dosaaf-1 consisting of A. Sultanova(captain), V. Vologzhanina, A. Kiskustina and N. Shveinova, winning 50.1 of the record points out of 75 possible.

The jump event for precision of landing from a height of 1000 meters was participated in only by the men.

The first place in this event was won by Ya. Klevchenko(Dosaaf of Leningrad) winning 11.56 record points out of a 25 possible. All the rest of the participants of the contest landed outside the circle.

In the tie of the third event, a combined jump for precision of landing from a height of 1000 meters with a 10 second delay opening of the parachute, first place among the men was won by the team of the Dosaaf of the USSR consisting of E. Naumenko (captain), P. Bannikov, S. Mitin and Yu. Peklin, winning 12.7 record points out of a possible 150, and among the women, the team of the Dosaaf of the Ukraine SSR, made up of A.Kolchugina(captain) L. Besnyaka, N. Katasanova and L. Maznichenko, winning 83.235 record points out of a possible 150.

In the competitions for the 4th exercise (event)-a jump from a height of 2200 meters with 30 second delay in the opening of the parachute--among the women teams the first place was won by the team of Dosaaf -1 made up of A. Sultanova (captain)

V. Vologzhanina, A. Mishustina and M. Skvelnova, winning 124 record points out of 150 possible.

Among the men teams in this event, parachute jumps were executed only by 3 teams who registered the following results: team of Dosaaf-2 consisting of V. Mariunkin(captain), S. Fomichev, [illegible] and [illegible], winning 130.5 record points out of a possible 150; the team of Dosaaf of Leningrad consisting of Ya. Klevchenko(captain), V. Gavrilkin, [illegible] and A. Fedorenko, winning 112 record points, and Dosaaf team of the Moscow Oblast consisting of F. Gukhoperov (captain), V. Gorbunkov, and [illegible] and [illegible], winning 78 record points. In conducting the individual championship [illegible] and women as a result of the sharp and keen sport struggle the title "Champion of the USSR in Parachute Sport for 1953" was won by the following: sportsman first class V. Frokin (Dosaaf Saransk) and sportswoman of the first class [illegible] (Chkalov Central aeroclub of the USSR)--for precision in landing from a height of [illegible] meters; sportsman first class F. Cherepanov("Lesovik") and sportswoman second class L. Nesmichenko(Dosaaf of the Ukraine SSR)-- in the combined jump; master of sport A. Sultanova(Dosaaf-1) -- in jumps for precision of delayed opening of the parachute.

During the time of the contest the participants trying for the championship of the USSR for parachute sport made 241 parachute jumps of which 20 jumps were in the daytime in open competition.

In 1953, the international meet of Soviet parachute sportsmen was held with the parachutists of Czechoslovakia and Bulgaria.

The international contests were held in Ostrava(Czechoslovakia) from 30 August to 2 September 1953.

The team of the Soviet Union was represented by the following: masters of sport P. Storchienko(captain and trainer, Moscow), V. Kostunov(Dnepropetrovsk), F. Klimov (Stalingrad), V. Seliverstova(Omsk), I. Fedchishin(Dnepropetrovsk) and N. Skcherbinin (Moscow).

As a result of the keen sport struggle the team of the sportsmen of the USSR won first place in jumps for precision of landing from a height of 600 meters winning 39 record points. Second place was taken by the parachute team of Bulgaria, which won 12 record points. The team of parachutists of Czechoslovakia, winning 8.75 record points came out in third place.

The team of the USSR occupied first place also in jumps for precision of landing from a height of 1000 meters, winning 60.65 record points. The team of Bulgaria came second, winning 42.2 record points. The team of Czechoslovakia won third place, winning 37.4 record points.

In the third event-- a combined jump from a height of 1500 meters with a 15 second delay in the opening of the parachute-- the first place was also won by the team of the USSR.

Out of the total of all three events the team of the USSR won 185.45 record points and came out in first place. Second place was won by the team of Bulgaria which won 126.85 record points. The team of Czechoslovakia, having won 116.32 points, took third place.

Valuable prizes were given to the team of the USSR, which won the highest places.

The technical sport results shown by the representatives of the team of the USSR in the international parachute contest in Czechoslovakia confirmed the high level of sport skill of the Soviet parachute sportsmen.

In 1949-1952, in accordance with the statement of the organization committee of the Dosaaf of the USSR, 26 outstanding masters and mistresses of sport: E. Vladimirskaya, N. Gladkov, A. Gusarova, A. Tigaev, G. Ivanov, N. Lisichkin, N. Loginov, A. Lukin, N. Mateev, A. Menyailo, D. Myznikov, T. Naumenko, G. Osvalts, B. Petrov, P. Polosukhin, G. Pyasetskaya, V. Romaniuk, I. Starchak, A. Foteev and others were awarded the highest sport title "Honored Master of sport of the USSR".

Among the honored masters and mistresses of sport the highest 30 have to their account more than 1000 parachute jumps. Among them are Savkin, Amintaev, Pysterikov, Zhvanov, Lukin, Gladkov, Nikitin, Tokhaev, Surtsov, Gudenko, Gromov, Letunov, Gamrekeshvili, Yadykin, Shilkov, Zhilkin, Butkov, Ugaranko, Tsinsky and others.

More than 2000 jumps were executed by V. Romaniuk, G. Ivanov, K. Malinko and I. Savkin.

In 1951-53 a group of the most experienced sportsmen were awarded the highest titles of the board of sport referees of the All-Union category. This title was awarded to V. Baranov, A. Belousov, N. Gladkov, D. Zhornik, N. Lisichkin, A. Mukhortov, B. Petrov, G. Pyasetskaya and P. Storchienko.

A large group of parachute sportsmen and masters of sport were given government awards for highest sport skill, demonstrated in the air parade in 1959 on the Day of the Air Force of the USSR. Among those receiving the award were the following: I. Borisov, A. Gudin, M. Nikitina, A. Ogloblina, A. Sultanova, V. Seliverstova, N. Shvetsova and others.

Among the women, the parachute sportswomen having the most jumps to their credit(more than 500) are the honored of sport G. Yusetskaya, A. Kolchugina and mistress of sport O. Sushchinskaya.

We may also note that the old generation of masters are marching shoulder to shoulder with the youth of today. Among such older people are the 60 year old master of sport A.A. Belusov and honored master of sport V.A. Kuznikov, who train the young generation of parachute sportsmen. Another one of the "older people" is the parachute packer, master of sport, N.V. Mayzov. In spite of their age they have not lagged behind in their field.

Mass Soviet parachute sport is only a little over 20 years old, but during this period our parachute sportsmen have won great victories. They have been able to master to perfection the parachute art, to win all the world parachute records and to consolidate firmly their world's championship in parachute sport.

On the basis of the decisions of the Central Committee of the All-Union Communist Party of the Bolsheviks of 27 December 1946, dealing with further development of the mass physical culture movement in the country and the raising of the skill of Soviet sportsmen, there have been worked out some new sport titles and classes in all forms of aviation sport; new sport norms have been approved, as well as a schedule of All-Union parachute records and the regulations for their registration.

In the training groups and the aeroclubs of the Dosaaf energetic sport work is being carried on. The young workers, collective farm members and participants in the youth organizations are studying the airplane, the glider, the parachute and constructing aviation gliders. They are making more and more records in the perfection of their skill, to the glory of their beloved fatherland.

A great program for further struggle and still more victories for all the Soviet people was constituted by the decision of the 19th Congress of the Communist Party of the Soviet Union, in the resolutions of which one provided for insuring further

development of physical culture and sport.

In carrying out the decision of the Congress of the Party, the Volunteer Society for Cooperation between the Army, Aviation and Navy of the USSR (Dosaaf), jointly with the Chief Directorate of Physical Culture and sport of the Ministry of Health of the USSR, organizes and guides sport work for the winning of the world's championship by the Soviet Union.

Chapter II

THE BASIC THEORIES OF THE PARACHUTE JUMP

CERTAIN INFORMATION CONCERNING MECHANICS

The work of the parachute from the moment it is put in action until the complete opening and the landing takes place during movement. For this reason the basic elements of the theory of the parachute jump are included in a number of phenomena treated in courses in mechanics and aerodynamics.

In order to understand properly the theory of a parachute jump, it is necessary first of all to get acquainted with certain principles of mechanics.

Mechanics, like all other sciences dealing with nature, not only describes the qualitative side of the phenomena studied but also determines the quantitative laws which constitute their basis. In order to determine the quantitative law of the phenomenon (process) to be studied, it is necessary first of all to define the measure of this phenomenon. The basic measurements in mechanics are length, force, and time. The units of these measures are: the meter (m), the kilogram (kg), the second (sec).

Mechanics is a science dealing with the laws of the movement of bodies. By movement in mechanics we understand any change in the position of a body in space.

Every mechanical movement is a relative movement, because in nature there are no stationary bodies. The movement of any body may be simple or complex, depending upon the object relative to which we consider it movement. For example, the movement of a parachute relative to the air will be simple. But, the movement of a parachute relative to the ground (when there is wind blowing) will be complex, made up of the movement of the parachute relative to the air and the movement of it together with the air relative to the ground.

SPEED

The first question which arises in the consideration of the movement of any body is the question of the speed of its movement.

In order to represent the speed of any movement, we give the path travelled by the body during a specified time. The path travelled by a body in a unit of time is called the speed.

In mechanics, translational speed is designated by the letter V and is measured in meters per second (m/sec) or in kilometers per hour (km/hr).

If the body moves over all the path at a constant speed, the value of the speed is determined by the formula:

$$V = \frac{S}{t}$$

where S is the path or distance travelled by the body: t is the time of movement.

If, however, the movement over the path considered took place at a variable speed, then, by dividing the total length of the distance travelled by the time, we obtain the average velocity, that is,

$$V_{cp(av.)} = \frac{S}{t} \quad \text{. . . cp = av. (average)}$$

Example, to determine the average speed of the vertical descent of the parachutist with the parachute open from a height of 600 m, if the time of descent to the ground is equal to 100 sec.

Solution: $V_{av.} = \frac{600}{100} = 6\ m/sec$

The average speed of irregular movement gives us only an approximate idea of the real velocity. The less the speed changes during the time of movement, the closer the average speed will be to the actual speed. The concept of average speed of movement is particularly important in practice, because in the majority of cases we must take into account precisely this average speed (the speed of an airplane, locomotive, parachute, etc.).

Let us suppose that the parachutist leaves the airplane at a height H and lands after T secs.

In this case the average speed will be: $V_{av} = \frac{H}{T}$

TRAJECTORY

The line along which a body moves is called the trajectory. Depending upon the form of the trajectory, all movement may be divided into rectilinear, that is, movement in which the trajectory is a straight line, and curvilinear, in the case of which the trajectory of the movement is a curve (a circle, parabola, etc.).

As an example of rectilinear movement we may take the fall of a body dropped without any initial velocity, the movement of a piston in a cylinder, etc.; as an example of curvilinear movement we have the movement of an airplane in a turn, the movement of a parachutist when he makes a jump from a flying airplane, etc.

A special case of curvilinear movement is movement in a circle.

THE BASIC LAWS OF MECHANICS

The basis of mechanics is constituted by three laws which were formulated by Newton.

The first law: Every body remains in a state of rest or uniform rectilinear motion until an external force causes it to change from this condition.

This law expresses a characteristic which is inherent in every material body, which consists in the ability or tendency to conserve its state of rest or uniform rectilinear motion in the absence of external actions. This characteristic of the body is called inertia, and the law is called the Law of Inertia.

The second law: The force acting on a body is equal to the product of the mass of the body by the acceleration communicated to the body by this force.

The mathematics of the second law of Newton may be expressed by the following formula:

$$P = mg$$

where P is the force acting in kg; g (j), the acceleration received by the body in m/sec^2; m, the mass of the body in $kg \times sec^2/m$.

From the formula it follows that the greater the mass of the body, the greater the force it is necessary to apply in order to obtain the same acceleration. Of course, with an increase in the mass of the body, it will show a greater resistance to forces striving to impart acceleration to it, that is, to change the velocity of the body in magnitude or in direction. Hence, the mass is regarded as a measure

of the inertia of any body. Two forces will be equal to each other if they communicate to one and the same body, an acceleration which is the same in magnitude and direction.

If an acting force is a force of weight (designated by the letter G), the formula written above will take the form:

$$G = mg$$

where G is acceleration of the force of gravity (constant for a given place on the surface of the earth).

Since the acceleration of the force of gravity is known, then, knowing the weight of a body, it is easy to determine its mass:

$$M = \frac{G}{g}$$

From this formula it follows that the masses of bodies are proportional to their weight (at a given place on the surface of the earth).

Example: To determine the masses of loads if their weights are equal to 98.1; 196.2; 294.3; 392.4 kg.

Solution: By substituting the weights in the loads in the formula, we obtain respectively, $m_1 = 10$; $m_2 = 20$; $m_3 = 30$; $m_4 = 40$.

Hence, by comparing the weight of the bodies by suspending them at the same place, we can in this manner compare their masses. In practice the suspension is done by means of weights.

The third law: If we apply force to a body, then we must have existing another force equal in value and acting in a direction opposite to the first (To every action there is an equal and opposite reaction.).

From this law it follows that in nature there are no single forces and that all forces are paired. If, for example, a book lying on the table exerts its pressure upon the table, the table exercises on the book a force equal to the value of the weight of the book but in an opposite direction.

The third law of mechanics is usually expressed briefly as follows: every action has an equal counteraction.

MASS DENSITY

The mass density of the air is the mass of air contained in one cubic meter.

The mass density of the air is measured in kg. x sec^2/m and is expressed by

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of the inertia of any body. Two forces will be equal to each other if they communicate to one and the same body, an acceleration which is the same in magnitude and direction.

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The third law: If we apply force to a body, then we must have existing another force equal in value and acting in a direction opposite to the first (To every action there is an equal and opposite reaction.).

From this law it follows that in nature there are no single forces and that all forces are paired. If, for example, a book lying on the table exerts its pressure upon the table, the table exercises on the book a force equal to the value of the weight of the book but in an opposite direction.

The third law of mechanics is usually expressed briefly as follows: every action has an equal counteraction.

MASS DENSITY

The mass density of the air is the mass of air contained in one cubic meter.

The mass density of the air is measured in kg. x sec^2/m and is expressed by

the letter P (Greek letter Rho).

The density of the air decreases with the increase in height.

SPECIFIC WEIGHT

The specific weight of a body is the weight of a unit volume of it.

The specific weight is designated by the letter Υ (Greek letter Upsilon) and is measured by a unit of weight divided by a unit of volume. For gases and vapors (including also the air) as a unit of specific weight we employ the kilogram divided by cubic meters (kg/m^3).

PRESSURE

The pressure is the force falling on a unit of surface. The pressure is designated by the letter P and is measured by the unit of force divided by a unit of surface. Usually, the pressure is measured in kilograms per square centimeter (kg/cm sq). We know that the atmosphere surrounding the earth presses upon the surface of the earth and all bodies which are on it and that this pressure will differ with the place and time.

On the average, at sea level, the atmospheric pressure upon each square centimeter of surface is 1.0333 kg, which corresponds to 760 mm of standard mercury at 0° Centigrade. Such a unit of pressure is called "physical atmosphere".

In technology, for convenience of calculation, we take as a unit of pressure 1 kg/cm^2, and the unit of measurement itself has been given the name of "technical atmosphere".

Technical atmosphere corresponds to 735.5mm of standard mercury. The measurement of the atmospheric pressure is made with a liquid barometer.

If we take a glass tube soldered at one end, pour mercury into it, then, upon closing the open end, place it in a vessel also filled with mercury, we see then, upon opening the tube that the mercury drops and stops at a definite level.

This shows that all the weight of mercury counterbalances the pressure of the atmosphere acting on the surface of the mercury in the vessel.

The height of the column of liquid in the tube depends upon the specific weight of this liquid.

Since the specific weight of mercury is 13.6 and the pressure of the atmosphere

is 1 kg/cm, it is not difficult to calculate that the height of the column of water pressing with a force of 1 kg/cm will be equal to 0.735mm.

If we pour water into a tube, then with its specific weight equal to 1, the height of the column will be 10 meters.

WORK

If a body moves overcoming some resistance, it performs work.

Work is measured by force multiplied by the distance travelled by the body (if the direction of the force coincides with the direction of movement of the body. As a unit of work in mechanics we take the kilogram multiplied by meters. Hence, in lifting a weight equal to 1 kg to a height of 1 meter, we perform work equal to 1 kgm. Work is designated by the letter A.

The ability of a body to perform work is called energy. We distinguish two kinds of energy:

a) Kinetic energy (or energy of movement) and

b) Potential energy (or energy due to position).

Kinetic energy at any moment of movement is equal to one-half the product of the mass of the body by the square of the velocity, that is $\frac{mV^2}{2}$, and is also called the vis viva of the moving body.

Let us suppose that the velocity of the body of a parachutist at the beginning of the filling of the canopy of the parachute is equal to:

$$A = \frac{mV_0^2}{2} - \frac{mV_H^2}{2},$$

which expresses the work of braking, produced by the parachute during the time of the filling of the canopy.

Example: To determine the work of the braking of the canopy of the parachute during the time of its filling, if the velocity at the beginning of filling is $V = 70$m/sec, and at the end $V_H = 15$ m/sec and the weight of the system is $G = 98$ kg.

Solution: $A = \frac{10 \times 70^2}{2} - \frac{10 \times 15^2}{2} = 23375$ kgm

If we assume that the canopy of the parachute is filled over a distance equal to 30 meters, then the average force of braking will be equal to:

$$R = \frac{A}{S} = \frac{23375}{30} = 779.1 \text{ kg.}$$

THE FALLING OF A BODY WITHOUT TAKING INTO ACCOUNT THE RESISTANCE OF THE AIR

Let us consider the simplest case of the falling of a body when the resistance of the air to the moving body is not taken into account. While neglecting the resistance of the air, we at the same time assume that the movement considered takes place in a space free of air (a vacuum).

Let us suppose that some body lifted to a height H is allowed to fall freely (Figure 1).

The body under the action of the force of gravity starts to drop in a direction towards the center of the earth. Let us determine what the velocity of the fall of the body will be at any given moment of time.

Galileo, in studying the fall of a body in a vacuum, found that the velocity of fall at any moment of time is expressed by:

$$V = gt$$

and that the distance travelled by the body will be:

$$S = \frac{gt^2}{2},$$

where V is the velocity of fall in meters/sec;

t - the time of fall in sec;

S - the distance travelled by the body during the time t, in meters;

g - the acceleration of the force of gravity in m/sec^2.

It is evident that both the velocity and the distance travelled by the body can be determined only on condition that we know the numerical value of g. Let us determine the numerical value of g. For this purpose it will suffice to measure the distance travelled by the body during a given time, and to substitute it in the latter formula, from which we determine the unknown value g. The measurement showed that the distance travelled by the freely falling body during the first second is equal to 490.5 cm. Placing this value in the formula we obtain:

$$490.5 = \frac{g \times 1}{2},$$

whence,

$$g = 981 \text{ cm/sec} = 9.81 \text{ m/sec}$$

(In reality, the value g is not a constant but depends on the latitude of the place on the surface of the earth and the height above sea level. The value 9.81 is the approximate value for our latitudes).

that is, the body falls in a vacuum with an acceleration equal to 9.81 m/sec.

If a body lifted to a height H starts to fall with a certain initial vertical velocity V_o, the formulas for velocity and distance travelled are written in the following form:

$$V = V_o + gt;$$

$$S = V_o t + \frac{gt^2}{2}.$$

FALLING OF A BODY RELEASED UNDER AN ANGLE TO THE HORIZON

In the cases considered by us we assume that the movement of the body is vertical along a rectilinear trajectory.

Let us show how a body will move when released under an angle to the horizon For the study of such movement it is necessary for us to calculate the velocity and the distance travelled in two directions: in the vertical and the horizontal. Let us suppose the vertical and horizontal axes to be shown in figure 2.

In order to find the velocity and the distance travelled at any moment, it will suffice to know the projection of the path and the velocity on the axes X and Y at any moment of time.

Let us suppose that a body is released with an initial horizontal velocity of V_o. The projections of the velocity and the distance travelled on the axes X and Y are determined by the formulas

$$V_x = V_o,$$

$$V_y = gt,$$

$$X = V_o t,$$

$$Y = \frac{gt^2}{2},$$

where V_x is the projection of the velocity on the axis X,

V_y, the projection of the velocity on axis Y.

The resultant velocity at any moment of time is determined b y the formula

$$V = \sqrt{V_x^2 + V_y^2}$$

If from the two preceding formulas we eliminate the time t, we obtain an equation of the trajectory of movement.

The trajectory of movement in the example given is a parabola.

From the first two formulas we can see that a body in this case will move so that the projection of the velocity on the horizontal axis will be a constant value equal to the initial velocity V_0 and that the vertical velocity and the distance travelled will be the same as if the body had fallen when released without any initial velocity. Hence, it follows that the body released in a vacuum without initial velocity or with any initial horizontal velocity falls to the ground in the same time.

In conclusion, we shall point out that if a body is released in a vacuum under any angle to the horizon (figure 3), the projection of the path and the velocity will be determined by the formulas:

$$V_x = V_0 \cos a,$$

$$V_y = V_0 \sin a \pm gt,$$

$$X = V_0 \cos a \cdot t,$$

$$Y = V_0 \sin a \cdot t \pm \frac{gt^2}{2}.$$

We saw that neigher the weight of the body nor the values characterizing the dimensions and the form of the body enter into the formula for determination of the velocity and the distance travelled. From this it is clear that the movement of a body in a vacuum does not depend upon the weight, form or dimensions of the body.

Example 1. The observer executed a jump from the basket of a captive balloon set fire by an enemy shell, and dropped for three seconds without opening of the parachute in order to get away the necessary distance from the burning balloon. Let us determine the velocity and the distance travelled by the end of the third second.

Neglecting the resistance of the air, the velocity of the body and the distance travelled are determined by the formulas:

$$V = gt = 9.81 \times 3 = 29.43 \text{ m/sec},$$

$$Y = \frac{gt^2}{2} = \frac{9.81 \times 3^2}{2} = 44.145 \text{ m}.$$

Since in reality the air offers resistance to a moving body, the velocity and distance travelled by the end of the third second will be less than those calculated.

Example 2: To determine the velocity acquired by a man making a parachute jump from a parachute tower until the moment of the tightening of the shrouds of the parachute, if we know that the slack of the shrouds is equal to 4 meters. From the formula we find:

$$Y = \frac{V^2}{2g}$$

$$V = \sqrt{2gY}.$$

Since Y = 4 m, then, substituting, we obtain:

$$V = \sqrt{2 \times 9.81 \times 4} = 8.85 \text{ m/sec.}$$

From the formula —

$$V = \sqrt{2gY}$$

we see that with an increase in height Y the velocity with which the body falls to the earth is also increased.

Will this increase be limitless? It turns out that it will not be. Calculations show that a body, when released at an infinitely great distance from the earth (without any initial velocity), will fall to the earth (the resistance of the air is not taken into account) with a velocity of V = 11180 m/sec.

The reverse statement is also true: a body released from the surface of the earth with a velocity V = 11180 m/sec, will not return but will move away from the earth to an infinitely great distance.

If we take into account the resistance of the air, the velocity which it is necessary to communicate to the body in this case will be greater.

THE ATMOSPHERE AND ITS CHARACTERISTICS

The earth is surrounded by an envelope of air which extends hundreds of kilometers upwards. The upper layers of the atmosphere press on the lower, as a result of which the most compressed layer of air is the one located near the surface of the earth.

The lower layers of air up to 11 km (near the poles) and 17 km (at the equator) are called the troposhere, and those above are called the stratosphere.

PRESSURE

With normal atmospheric conditions the air presses on 1 cm square of earth surface with a force of 1 kg. With a change in the temperature of the air, there is a change in pressure. The pressure is measured by the height in millimeters of a column of mercury.

DENSITY

Mass is numerically equal to the weight of a unit volume of substance divided by the acceleration of the force of gravity.

Density is the quantity of substance contained in a unit of volume.

Under normal atmospheric conditions (a pressure of 760 mm, temperature 15° C.) one cubic meter of air weighs 1.225 kg.

Let us determine the mass density of the air on the ground:

$$P_0 = \frac{1.225}{9.81} = \frac{1}{8} = 0.125 \quad \left(\frac{kg.sec^2}{m^4}\right)$$

With an increase in altitude the density of the air decreases.

The value of the mass density for the different altitudes is given in handbooks and for a height up to 12 km one can calculate it roughly by an approximate formula (V.P. Vetchinkin, Dynamics of the Airplane, GOS Mashmetizdat, 1933) :

$$PH = P_0 \frac{20 - H}{20 + H},$$

where PH is the mass density of the air at height H;

H, the height in km.

RELATIVE DENSITY OF THE AIR

The relationship of the density of the air at an altitude to the density of the air on the ground is called the relative density and is designated by :

$$\Delta = \frac{PH}{P_0}$$

or approximately (loc. cit.)

$$\Delta = \frac{20 - H}{20 + H}$$

At the ground $\Delta = 1$

At an altitude of 6.5 km $\Delta = 0.5$

At a height of 12 km $\Delta = 0.25$

This example shows that a heights of 12 km and 6.5 km, the density of the air is four times and two times respectively greater than the density of the air on the ground.

With a decrease in the density of the air at altitudes there is also a decrease in the oxygen content of the air. Hence, beginning with 5 to 6.5 km, flights are made with oxygen aparatus, and at heights of more than 10 km, they are made in hermetically sealed cabins.

The oxygen aparatus provides the aviator only with the oxygen necessary for breathing and the hermetically closed cabin isolates the aviator from the rarified air medium, low temperatures and pressure. Flights without such a cabin are dangerous for man at altitudes exceeding 10 km.

TEMPERATURE

The temperature of the air changes with a change in altitude.

Up to 10 km the temperature of the air decreases by 6.5 degrees for every 1000 meters and may be calculated by the formula:

$$t^{\circ}_{H} = t^{\circ}_{0} - 6.5\,H$$

where t°_{H} is the temperature at the height H; H, the height in kilometers;

In our latitudes, at heights beginning with 11-12 km (the stratosphere), the temperature of the air becomes constant and totals approximately 55 degrees C.

In separate cases, especially in the winter time, we may observe an increase in the temperature of the air up to a certain elevation with a subsequent decrease. This phenomenon of the increase of temperature with an increase in height is called inversion.

On a summer night, when the ground gives off heat to the air by radiation, the phenomenon of inversion is also observed, although to a lesser degree.

HUMIDITY

The humidity of the air is the amount of water vapor which it contains. The number of grams of water vapor contained in one cubic meter of air is its absolute humidity.

At a given temperature, the air can contain a definite quantity of moisture, and the excess of moisture is deposited in the form of dew, etc. The relative

humidity is the ratio of the absolute humidity to the quantity of vapor saturating the air at the given temperature (in per cent).

For example, if one cubic meter of air contains 13 grams of water vapor and 15 grams are needed to saturate it, the relative humidity is equal to $\frac{13}{15}$ or 86.6%.

The humidity of the air is measured with the hydrometer or the psychrometer (table 1).

In the absence of the hygrometer we can determine the relative humidity by means of two thermometers. This we do as follows: The end of one of the thermometers containing the mercury is wrapped with a piece of fabric and moistened with water. By calculating the differences of the readings between the thermometers and making use of the psychrometric table, we determine the relative humidity of the air.

Table 1

PSYCHROMETRIC TABLE

For temperatures from 0 to +25 degrees on the moist thermometer

Index of humidity of the thermometer in degrees C.	Difference of the readings between the dry & moist thermometers										
	0	1	2	3	4	5	6	7	8	9	10
	Relative humidity of the air in per cents										
0	100	81	64	50	36	26	16	7	—	—	—
1	100	82	66	52	39	29	19	11	—	—	—
3	100	83	69	56	44	34	26	17	10	—	—
5	100	85	71	59	48	39	30	23	17	10	—
7	100	86	73	62	52	43	35	28	22	15	11
9	100	86	75	65	55	47	39	32	27	21	17
11	100	88	77	67	58	50	43	36	30	25	20
13	100	89	78	69	61	53	46	40	34	29	24
15	100	89	80	71	63	55	49	43	37	33	28
17	100	90	81	73	65	58	52	46	40	36	31
19	100	91	82	74	66	60	54	48	43	39	34
21	100	91	83	75	68	62	56	51	46	41	37
23	100	91	83	76	69	63	58	53	48	43	39
25	100	92	84	77	70	65	59	54	50	45	42

Example: The dry thermometer shows +15 degrees C., and the moist shows +9 degrees C. The difference between the readings of the dry and moist thermometers is $15^\circ - 9^\circ = 6^\circ$.

In accordance with the table, on the intersection of the horizontal line "9" with the vertical column "6", we obtain a relative humidity equal to 39%.

In places where parachutes are stored, the relative humidity should be from 40 to 60%.

MOVEMENT OF THE AIR

The movement of the air (wind) occurs as a result of the irregular heating of the surface of the earth and the irregular distribution of the pressure. The air most often moves in a horizontal direction from places with a high atmospheric pressure to places with a lower atmospheric pressure. The wind is characterized by velocity and direction. The velocity of wind at the surface of the earth is somewhat reduced as a result of the friction with the surface of the earth. But, with an increase in altitude, not only the velocity of the wind changes, but also its direction. Sometimes these changes are very great. The gustiness of the wind decreases with an increase in height.

The velocity of the wind usually increases towards the midday hours and decreases towards evening. At night, after the weather settles, we observe a weakening of the wind or even a calm (no wind).

Table 2

INTERNATIONAL STANDARD ATMOSPHERE UP TO HEIGHTS OF 20,000 METERS

Height, m.	Pressure P, mm standard mercury	Temperature in degrees C.	Relative Density	Density P
Troposphere				
-1,000	854.6	+21.50	1.0976	0.1374
0	760.0	+15.00	1.0000	0.1250
1,000	674.1	+ 8.50	0.9078	0.1134
2,000	595.1	+ 2.00	0.8215	0.1027
3,000	525.7	- 4.50	0.7410	0.0927
4,000	462.2	-11.00	0.6663	0.0836
5,000	405.0	-17.50	0.6007	0.0751
6,000	353.7	-24.00	0.5383	0.0673
7,000	307.8	-30.50	0.4810	0.0601
8,000	266.8	-37.00	0.4284	0.0536
9,000	230.4	-43.50	0.3804	0.0476
10,000	198.1	-50.00	0.3366	0.0421
11,000	169.6	-56.50	0.2968	0.0371
Stratosphere				
11,000	169.6	-56.50	0.2968	0.0371
12,000	144.8	-56.50	0.2535	0.0317
13,000	123.7	-56.50	0.2165	0.0271
14,000	105.6	-56.50	0.1849	0.0231
15,000	90.25	-56.50	0.1579	0.0197

16,000	77.1	-56.50	0.1349	0.0167
17,000	65.9	-56.50	0.1153	0.0144
18,000	56.2	-56.50	0.0984	0.0123
19,000	48.0	-56.50	0.0841	0.0105
20,000	41.0	-56.50	0.0718	0.0090

The wind plays a great part in parachute jumps, especially at the moment of landing. With strong wind, landing is rendered much more difficult.

For observation of the wind, on airports there are weather vanes or wind socks. The latter consist of a conical shaped fabric sack without a bottom. The wind sock is fastened to a staff at a height of 4 to 5 meters from the ground or on the roofs of buildings and hangars. When the wind blows, the sock is distended and turns in the direction toward which the wind is blowing. The velocity of the wind on the ground is determined by instruments. The simplest and most precise device is the Fuss anemometer. The direction of the wind on the ground may also be determined by the movement of the smoke on the horizon.

The determination of the velocity and the direction of the wind at higher altitudes is done by means of pilot balloons.

RESISTANCE OF THE AIR TO THE MOVEMENT OF BODIES

General Statement:

To eachbody in movement, the air offers a definite resistance which we shall call from now on, the force of the resistance of the air.

The force of resistance of the air to any body is the same regardless of whether or not the body moves relative to stationary air at a given speed or if the air moves at the same velocity relative to a stationary body.

This fact makes it possible to test models of flying machines (airplanes, dirigibles and others) in the wind tunnel, in which there moves a current of air and the model is stationary.

The science dealing with the study of the movement of a body in the air is called aerodynamics. The resistance of the air to a moving body is governed by a precise law. This law is the basic law of aerodynamics and may be formulated in the following manner. The force of resistance of the air to a moving body is

directly proportional to the density of the air, the area of resistance, the square of the velocity and the coefficient of resistance.

If we designate:

R, the force of resistance in kg

P (Rho), the mass density of the air in $\frac{kg \times sec^2}{m^4}$

S, the area of resistance in square meters

V, the velocity of the movement in m/sec

C_x, the coefficient of the frontal resistance, then the basic law of resistance of the air may be written as follows:

$$R = \frac{PV^2}{2} C_x S.$$

In this formula, for the determination of R, it is necessary to know the coefficient of the frontal resistance C_x, because all the rest of the values may be considered as given in some other way.

Let us consider various bodies flown around by a current of air.

The visible picture of the flow of air around a body is call an aerodynamic spectrum.

In order to obtain spectrums, aerodynamics makes use of different methods. One of the simplest methods for obtaining a visible picture of the flow of air around a body is the putting of smoke in the current of air. If the body which is in the flow, we apply a stream of smoke or smear the surface of the body with a smoke producing liquid, the smoke renders the flow (of air) visible.

The picture obtained of the flow around the body is made with a photographic or a movie camera.

In figures 4, 5, and 6, we see that the plate inserted perpendicularly to the current, and also the sphere and the wing of the airplane are flown around by a current of air but not smoothly. It is obvious that immediately behind the body there is formed a zone of disturbed air characterized by the formation of a whirl. The larger the zone of disturbance (or whirl) behind the body, the greater the resistance the body experiences when moving in the air. This is explained by the fact that a considerable part of the energy of motion is expended in the formation

of the whirl. Hence, for decreasing the resistance experienced by a body while it is moving in the air, it is necessary that the flow of air around the body be smoother, that is, we must decrease to a minimum the dimensions of the whirl forming behind the body.

In figures 7, 8, and 9, we see a flow around the same bodies as in figure 4, 5, and 6, but arranged differently with respect to the direction of the flow of the current of air. We see that the given bodies in this case are flown around smoothly, that is, without the formation of whirls and as a result, they experience reduced resistance to the air. It is not difficutl to guess that the streamline characteristics of a body depend on its shape. Hence, in aerodynamics we consider carefully forms of bodies that are well streamlined and thos which are poorly streamlined. We see then that two bodies, moving at the same velocity in air with one and the same velocity, with the same cross-section area, will experience a different force of resistance depending upon their shape.

Let us suppose that some two bodies move in the air. The force of resistance may be expressed by the formulas:

$$R_1 = \frac{P_1 V_1^2}{2} C_{x_1} S_1$$

$$R_2 = \frac{P_2 V_2^2}{2} C_{x_2} S_2$$

If, $P_1 = P_2$, $V_1 = V_2$, $S_1 = S_2$, then by dividing the first formula by the second, we obtain:

$$\frac{R_1}{R_2} = \frac{C_{x_1}}{C_{x_2}}$$

The latter formula shows that the value of the force of resistance is directly proportional to the coefficient of the frontal resistance of the body. Hence, the aerodynamic qualities of the body are fully characterized by a knowledge of its coefficient of resistance.

The coefficient of frontal resistance depends chiefly on the form of the body and also on a good many other factors, for example, on the roughness of the surface, and is determined by the method of blowing over the body or its model in the wind tunnel. Usually, when the body moves (airplanes, dirigibles, automobiles, etc.),

the resistance of the air is a negative factor; hence, in the construction we try to give to the body a good streamlined form. The most streamlined form is that having the shape of a drop (figure 10).

In figure 11, we have given the values of the coefficients of resistance of bodies having the same cross section. From the data of the drawings we can see that these values differ greatly. For example, the coefficient of the resistance of the cup (figure 12) turned with its convexity toward the flow is four times less than in the case if its reverse side is turned towards the flow.

Figure 11.

No.	Form of Body	C_x	Remarks
1	Cone	0.510	Arrow indicates direction of flow
2	Cone	0.328	Ditto
3	Cone-hemisphere	0.160	Ditto
4	Cone-hemisphere	0.085	DITTO
5	Hemisphere-cup	1.440	Ditto
6	Hemisphere-cup	0.360	Ditto

THE MOVEMENT OF THE PARACHUTIST IN THE AIR WITHOUT OPENING OF THE PARACHUTE

Let us consider what resistance is offered to the body of the parachutist falling in the air.

As a result of the fact that the body of a man has projecting extremities (arms and legs) it is poorly streamlined and in movement, the air offers it a great deal of resistance. We know that for the determination of the forces of resistance acting upon a body with a given area of resistance, density of the air

and velocity of movement, it is necessary to determine by experimental methods the coefficient of the frontal resistance of the given body. However, the task of determining the coefficient of resistance of the falling body of the parachutist is complicated by the fact that while falling in the air the body of a man may assume various positions relative to the direction of movement, as a result of which his resistance will also be changed. Since the positions which the body of a man may assume in a free fall may be infinite in umber and since these positions are due to causes difficult to take into account, then it is entirely useless to try to determine the actual resistance of the falling body of a man. However, such a conclusion should not confuse us, because for practical purposes it will suffice to be able to determine the average value of the resistance of the falling body of the parachutist.

We shall assume that the average area of the body of a man, to which we shall assign a coefficient of resistance, is equal to 0.5 m square.

By forcing a current of air in the wind tunnel over the model of the body of the parachutist, it was found that C_x, referred to the average surface, changes within considerable limits, depending upon the position of the body of the man.

Figures 13 and 14 show the model of the body of the parachutist made 1/5 the natural size, being subjected to a flow of air in the wind tunnel. The model was prepared on the basis of drawings obtained from the measurements of a man having a height of 170 cm of normal stoutness.

In figure 15, we see the position of the model of the body of the parachutist during the time that air is being forced over it in the wind tunnel. We give to the model the posture which a man may assume in a jump before the opening of the parachute. The model is arranged under an angle of 45 degrees to the vertical.

In table 3, we have given the value of the coefficient of the frontal resistance of the body of a man in this position.

For the parachutist falling at velocities of 50 to 100 m/sec, we take $C_x = 0.8$, referred to the average area of restance equal to 0.5 m^2 (The forcing of air over the model of the body of a man was carried out in the vertical tunnel of the aerodynamic laboratory of the Scientific Research Institute of the M.G.U. in 1936).

THE VALUE C_x OF THE MODEL OF THE BODY OF A MAN Table 3

C_x is referred to an area equal to 0.5 m^2. The model is in the position of jumping under an angle of 45 degrees to the vertical.

V m/sec	C_x	V m/sec	C_x
4.1	1.02	10.2	0.978
5.1	1.016	13.3	0.992
7.2	0.992	16.5	0.992

DETERMINATION OF THE VELOCITY OF FALL OF THE PARACHUTIST WITHOUT OPENING OF THE PARACHUTE

Suppose the parachutist starts to fall without initial velocity, for example, from a captive balloon.

We know that on a body falling in the air, there will act, in addition to the force of gravity G, a force of resistance, R. Let us determine in what directions the aforementioned forces will act.

We know that the force of gravity acts in all cases vertically downward; as concerns the forces of resistance R, we will say that its direction at any given moment is opposite the direction of travel. And, since the body of the parachutist in this case has only a vertical velocity, then, obviously the force of the resistance is directed vertically upward. The direction of the force is shown in figure 16. Let us consider how the velocity of the fall of the body of the parachutist will change. By studying the fall of bodies in a vacuum, we see that the velocity at which the body falls to the earth will be all the greater the higher the altitude from which the body is dropped. Will the velocity of the body falling in the air be subject to this law? In accordance with the basic law of resistance, we know that

$$R = \frac{PV^2}{2} C_x S$$

In the case considered by us, the velocity at the beginning of the fall is equal to 0. Hence, R is also equal to 0. In the following moments the velocity of the movement will increase, while the force or resistance, as wee see from the formula, will increase proportionally to the square of the velocity. Since the force of resistance will increase with an increase in velocity, and the force of

gravity will remain constant all the time, then after the passage of a certain time, there comes a moment when the forces of resistance becomes equal to the weight of the parachutist.

In view of the fact that the forces R and G are directed in the opposit directions, the resultant of these two forces will be equal to 0, that is, the forces R and G counterbalance each other. In accordance with the first law of mechanics, a body in this case can move only rectilinearly and uniformly. In our case this means that the velocity after reaching a certain limit, will conserve its value if the values $C_x P$ (Rho) and S, on which the resistance depends, are constant.

The velocity which is attained by the falling body, beginning from the moment when in the force or resistance becomes equal to the weight of the body, is called the limit (or critical) velocity and is designated by V_{kp}. For the determination of the limit (or critical) velocity, it is necessary to place in the formula for resistance, instead of the Force R, the weight of the body G; then we have:

Whence

$$R = G = \frac{PV^2}{2} C_x S,$$

$$V_{kp} = \sqrt{\frac{2G}{PC_x S}} \text{ m/sec}$$

Where G is the weight of the parachutist with the parachute;

S, the average area of resistance of the parachutist, which is taken as equal to 0.5 m^2;

C_x, the coefficient of the frontal resistance referred to the area S; we take it equal to 0.8;

P, the mass density of the air.

After substituting C_x and S with the numerical values, we obtain:

$$V_{kp} = \sqrt{\frac{2G}{P \times 0,5 \times 0,8}}$$

or

$$V_{kp} = 2.236 \sqrt{\frac{G}{P}}$$

With an increase in the height, the density of the air decreases and the critical velocity increases.

In Table 4, we have the values of the critical velocities of fall of a parachutist

weighing 80 and 100 kg. In Table 5, we have the values of the velocity of fall of the body of a parachutist (or dummy) from a height of 5000 meters.

Table 4

CRITICAL VELOCITIES

For a parachutist weighing 80 kg (with the parachute on)		For a parachutist with a weight of 100 kg (with the parachute on).	
For height 0 m	56.5 m/sec	For height 0 m	63.2 m/sec
" " 1,000	59.4	" " 1,000	66.4
" " 2,000	62.4	" " 2,000	69.7
" " 3,000	65.5	" " 3,000	73.3
" " 4,000	69.3	" " 4,000	77.5
" " 5,000	73.2	" " 5,000	81.9
" " 6,000	77.5	" " 6,000	86.6
" " 7,000	82.1	" " 7,000	91.8
" " 8,000	86.9	" " 8,000	97.1
" " 9,000	91.9	" " 9,000	102.8
" " 10,000	97.0	" " 10,000	108.9

Remark: The value of the density of air is taken for international standard atmosphere.

Table 5

THE VALUE OF THE VELOCITY AND DISTANCE OF FALL

OF A PARACHUTIST (OR DUMMY) RELEASED FROM A HEIGHT OF 5000 METERS

with $V_0 = 0$; $G = 80$ kg; $C_x = 1$; $S = 0.5$ m^2

t sec	V m/sec	H m	t sec	V m/sec	H m	t sec	V m/sec	H m
0	0	0	5.8	45.8	147.5	11.8	60.7	477.9
0.2	2.0	0.8	6.2	47.7	166.2	12.2	61.0	502.3
0.6	5.9	1.8	6.6	49.4	185.6	12.6	61.3	526.7
1.0	9.7	4.9	7.0	50.9	205.7	13.0	61.5	551.3
1.4	13.5	9.5	7.4	52.3	226.4	13.4	61.7	576.0
1.8	17.2	15.7	7.8	53.6	247.5	13.8	61.9	600.7
2.2	20.8	23.3	8.2	54.7	269.2	14.2	62.1	625.5
2.6	24.3	32.4	8.6	55.8	291.3	14.6	62.2	650.3
3.0	27.6	42.7	9.0	56.7	312.8	15.0	62.3	675.2
3.4	30.7	54.4	9.4	57.5	335.6	15.4	62.3	700.1
3.8	33.7	67.3	9.8	58.2	358.8	15.8	62.4	725.0
4.2	36.5	81.3	10.2	58.8	382.2	16.2	62.5	750.0
4.6	39.1	96.5	10.6	59.4	405.8	16.6	62.5	775.0
5.0	41.5	112.6	11.0	59.9	429.7	17.4	62.5	825.0
5.4	43.7	129.6	11.4	60.3	453.7	17.0	62.5	800.0
						17.8	62.5	850.0

Here t is the time from the beginning of the fall; V, the velocity for a given moment; H, the distance travelled along the vertical during the time t.

A JUMP FROM AN AIRPLANE FLYING HORIZONTALLY

Let us now consider the fall of the parachutist making a jump from an airplane flying horizontally. At the moment of the separation from the airplane, the parachutist may have a velocity, in value and direction, equal to the velocity of the airplane.

In the succeeding moments, under the action of the force of gravity, the parachutist will acquire a vertical velocity, while the horizontal velocity will decrease. At the moment the parachutist reaches the critical velocity, the horizontal velocity, received at the moment of separation from the airplane, will be equal to 0. As a result of the comparatively slow increase in the vertical velocity, the resultant velocity in the successive moments after separation from the airplane will decrease.

In table 6 we have the change of the resultant velocities in the course of two seconds after the separation of the parachutist released at a different horizontal velocity. On the basis of the data of the given table, we have constructed a graph of the dependence of the resultant speed upon the time of fall (Figure 17). From this graph we can see that the greater the velocity of the body of the parachutist at the moment of separation from the airplane, the more quickly it decreases.

Table 6

THE VALUES OF THE RESULTANT VELOCITY OF MOVEMENT AND THE DISTANCE TRAVELLED BY THE PARACHUTIST (75 KGM) RELEASED AT A DIFFERENT HORIZONTAL SPEED.

t sec	V_0= 150 km/hr = 41.7 m/sec			V_0= 250 km/hr = 69.4 m/sec			V_0= 350 km/hr=97.2 m/sec		
	V m/sec	X m hor.	Y m vert	V m/sec	X m hor.	Y m vert	V m/sec	X m hor.	Y m vert.
0	41.7	0	0	69.4	0	0	97.2	0	0
0.2	40.5	8.2	0.2	66.1	13.6	0.19	90.8	18.8	0.19
0.4	39.5	16.2	0.8	63.2	26.5	0.76	85.3	36.4	0.75
0.6	38.6	23.3	1.7	60.6	38.8	1.68	80.6	52.9	1.65
0.8	37.9	30.9	3.0	58.2	50.6	2.95	76.1	68.5	2.91
1.0	37.3	36.3	4.7	56.1	62.0	4.55	72.3	83.3	4.46
1.2	36.9	45.4	6.7	54.2	72.8	6.47	69.0	97.3	6.31
1.4	36.5	52.4	9.0	52.6	83.3	8.7	65.9	110.6	8.46
1.6	36.3	59.1	11.7	51.1	93.3	11.23	63.3	123.4	10.9
1.8	36.1	65.7	14.7	49.8	103. 0	14.06	60.9	135.5	13.5
2.0	35.9	72.2	18.0	48.7	112. 3	17.17	58.4	147.1	16.5

The graph of the change of velocities of fall of the parachutist for the case of a vertical initial velocity is given in Table 7 and in Figure 18.

Table 7

THE VALUE OF THE VELOCITY OF MOVEMENT V AND THE DISTANCE TRAVELLED Y OF A PARACHUTIST (OR DUMMY) RELEASED AT DIFFERENT INITIAL VERTICAL VELOCITIES V_0

t sec	V_0 = 400 km/hr = =111.11 m/sec		V_0 = 350 km/hr= = 97.2 m/sec		V_0 = 300 km/hr= = 83.3 m/sec	
	V	Y	V	Y	V	Y
0.0	111.11	0.00	97.20	0.00	83.33	0.00
0.2	108.27	21.57	90.49	27.49	79.28	25.47
0.4	97.63	42.30	86.71	45.65	77.39	41.49
0.6	90.65	75.06	81.79	70.88	73.56	64.13
1.0	86.89	96.67	79.04	87.08	71.72	76.61
1.5	79.36	138.36	73.44	124.66	67.78	112.99
2.0	73.44	175.37	69.04	160.48	64.45	145.60
t sec	V_0 = 250 km/hr = = 69.4 m/sec		V_0 = 200 km/hr = = 55.55 m/sec		V_0 = 150 km/hr = = 41.67 m/sec	
	V	Y	V	Y	V	Y
0.0	69.44	0.00	55.55	0.00	41.67	0.00
0.2	66.64	13.03	52.45	16.75	42.67	12.59
0.4	63.87	25.30	50.42	28.35	43.39	21.10
0.6	61.23	36.86	54.78	44.91	44.14	34.48
1.0	58.64	47.11	54.76	52.94	44.66	43.28
1.5	56.34	63.96	54.22	81.46	45.83	65.96
2.0	54.51	125.78	53.78	110.06	46.62	89.10

All the previously given considerations pertaining to the relative change of speed for cases of fall with a horizontal initial velocity remain valid. The difference consists in the fact that the velocity of the fall in the last moments will increase, if the initial velocity at the height of release was less than the critical, the manner in which the velocity changes in a period of 2 seconds is shown in Diagram 11.

From Table 6, we can see that when the parachutist has a horizontal initial velocity, the loss of altitude during a unit of time is insignificant, and all the less so, the greater the initial velocity. If, however, the initial velocity is vertical, the loss of altitude during a unit of time is considerable and increases with an increase in the initial velocity.

Let us note that in the calculations, we assumed in both cases that the release

of the dummy (or parachutist) takes place at a height of 500 meters. Hence, regardless of the value and direction of the initial velocity, the body of the parachutist, after the passing of a certain interval of time, reaches the critical velocity. The value of the critical velocity depends on the weight and form of the parachute and has a definite value for the given height.

CALCULATION OF A JUMP WITH DELAYED OPENING OF THE PARACHUTE

Let us show by a concrete example the method of approximate calculation of a jump with delayed opening of the parachute.

The jump is executed from an airplane flying horizontally at a height of 5000 meters, and under normal atmospheric conditions on the ground.

($\theta° = 15° C.$; $P = 750$ mm standard mercury.) The weight of the parachutist with the parachute, $G = 100$ kg.

It is necessary to determine the time from the moment of separation from the airplane until the moment of the functioning of the parachute at a height of 500 meters from the ground.

1. Let us determin t_1, the time it takes to drop the first 500 meters (from 5000 meters to 4500 meters).

In accordance with the table 8 $t_1 = 10.5$ sec.

Table 8

Height, in meters	Time for dropping the first 500 meters, in seconds
From 2000 to 1000	12
From 4000 to 2000	11
Over 4000	10.5

2. Let us determine the critical velocity at a height of 4500 meters:

$$V_{kp\ 4500} = 2.236 \quad \frac{Q}{P_{4500}} = 2.236 \quad \frac{100}{0.0792} = 79.3 \text{ m/sec}$$

3. We determine the critical velocity at a height of 500 meters (the height at which the parachute starts to function):

$$V_{kp_{500}} = 2.236 \quad \frac{100}{0.1191} = 64.8 \text{ m/sec}$$

4. We determine the average critical velocity on the sector of fall from 4500 to 500 meters:

$$V_{kp(cp)} = \frac{V_{kp_{4500}} + V_{kp_{500}}}{2};$$

$$V_{kp(cp)} = \frac{79.3 + 64.8}{2} = 72.05 \text{ m/sec}$$

kp = critical; cp = average

5. We define t_2 as the time of the drop on the sector of fall from 4500 to 500 meters:

$$t_2 = \frac{4500 - 500}{V_{kp(cp)}} =$$

$$= \frac{4000}{72.05} = 55.51 \text{ sec.}$$

6. Let us determine the total time of drop in a jump with delayed opening of the parachute from 5000 to 500 meters:

$$T \text{ total} = t_1 + t_2;$$

$$T \text{ total} = 10.5 + 55.51 = 66 \text{ sec.}$$

Figure 19 shows the diagram for the calculation.

Table 9

Height of jump in meters	Total time of fall in a jump with delayed opening of the parachute, in seconds
1,000	12
1,500	20
2,000	27
2,500	33
3,000	40
3,500	47
4,000	54
4,500	60
5,000	64

In Table 9, we have the permissible time T total of the drop from various heights down to 500 meters. At a height of 500m we expect to have an opening of the parachute.

The weight of the parachutist with the parachute is 100 kg.

In the calculations carried out under conditions different from those given above, ($t^0 = 15^0$ C. and H = 760mm), it is necessary to introduce corrections chiefly for the change of temperature (a rise of temperature).

Example: With an increase in temperature on the ground up to plus 44 degrees, the calculated time of drop T_{total} should be decreased by 7%.

Following the example considered, it is not difficult to make the calculation for a jump with a delayed opening of the parachute, executed from any height. If the parachutist drops flatwise, that is, with his face down, with his arms and legs out to the side, the actual velocity of fall of the parachutist will be less than that calculated and the parachutist using the calculated time brings the parachute into action at a height greater than 500 meters. In other words, the actual time of drop to a height of 500 meters in this case will be somewhat greater than that given in Table 9.

For the calculation of jumps with delayed opening of the parachute, executed from a diving airplane, the method of calculation cited is not applicable.

THE OPENING OF THE PARACHUTE

Putting the Parachute into Action

The putting of the parachute into action is done either immediately after the separation of the parachutist from the airplane (normal jump) or after the passing of a certain interval of time (a jump with delayed opening of the parachute). Depending upon the interval of time after which the parachute is put in operation, its opening will take place under different conditions.

The moment of placing the parachute in action coincides with the pulling of the rip cord ring with the cable, by the parachutist himself, or the pull cable fastened by one end to the airplane.

We have already noted that the velocity of movement of the body of the parachutist in the air changes with the passing of time both in value and in direction. At the moment of the separation, the parachutist has a velocity equal to the velocity of the airplane. Subsequently, the horizontal projection of the speed decreases, whereas the vertical increases. After the passing of a certain interval of time, the body of the parachutist loses completely its horizontal velocity. Figure 20 is a schematic representation of the velocity of movement of the parachutist in the air at different moments after his leaving the airplane. If the parachute is opened immediately after separation from the airplane, its opening will take place chiefly under the influence of the horizontal velocity.

Let us see whether or not the position of the body of the parachutist at the moment of the pulling of the rip cord ring exercises any influence upon the opening of the parachute, that is, at the moment of the opening of the pack. Let us suppose that the parachutist drops with his back downwards, as shown in Figure 21. After leaving the pack, the pilot parachute in this position of the parachutist must prove to be ineffective. In this case the following positions of the pilot parachute can interfer with the normal opening: compression of the pilot parachute against the back of the parachutist by a current of air; the falling of the pilot parachute between the arm and the body or between the leg and body of the parachutist.

Both in the first and in the second cases the pilot parachutist will be ineffective for a certain time and the opening will take place with a certain delay. In view of the fact that the body of the parachutist quickly changes its position relative to the direction of movement, the delay in the opening will be insignificant (it is calculated in fractions of a second). The fact is that after the passing of a certain interval of time, the body of the parachutist necessarily takes a position in which the pilot parachute comes into the current ofair, after which the opening will take place normally.

The normal position of the body of the parachutist at the moment of the pulling of the ring is shown in Figure 22. In this case the pilot parachute, when released from the pack, immediately falls into the current of air and its opening take place normally.

We have pointed out only two positions of the body of the parachutist relative to the direction of movement. As a rule, however, his body at the moment of the drop may have any position he may choose, if the parachutist does not have time for giving to his body a definite position (for example , in the execution of a normal jump), or when the parachutist has not mastered the technique of controlling his body during the drop with delayed opening of the parachute. Hence, one of the requirements made of the parachute is that its functioning be reliable, regardless of the position of the body of the parachutist when the parachute starts to function.

The majority of the existing constructions of parachutes, as shown by practice,

meet this requirement.

OPENING OF THE PARACHUTE

The opening of the parachute in the air usually takes place in three basic stages: the pulling out of the canopy and the shroud lines of the parachute from the pack, the pulling of the cover from the canopy, and the filling of the canopy with air.

If no cover for the canopy is used, the opening of the parachute takes place in two stages.

The pulling out of the canopy and the shroud lines: Upon pulling the rip cord ring with the cable, we open the parachute pack and release the pilot parachute. After getting in the stream of air, it quickly straightens out.

After opening, the pilot parachute is braked almost instantly by the resistance of the air and loses speed. Practically speaking, we may say that the pilot parachute, after leaving the pack is stopped, because the velocity of its movement is insignificant in comparison with the velocity of the movement of the body of the parachutist. Hence, the pilot parachute, leaving the body of the parachutist, pulls from the pack at first the canopy and after this, the shroud lines of the parachute. In proportion as the weight of the canopy and shroud lines shift to the pilot parachute, the pulling out of the parachute is delayed. The canopy and its shroud lines are pulled out fully, whereas the distance between the pilot parachute and the body of the parachutist becomes equal to the length of the shroud lines plus one-half the diameter of the canopy and plus the length of the cover of the canopy.

The greater the velocity of movement of the parachutist, the quicker the pulling out of the canopy and the shroud lines of the parachute. An increase in the dimensions of the pilot parachute, with keeping of all the rest of the conditions, reduces the time of the pulling out of the canopy from the shroud lines.

By reason of the fact that the range of speed at which the parachute is set in operation varies within wide limits, the time of the drawing out of the canopy and the shroud lines also varies in different cases. The time for the drawing out

of the canopy and the shroud lines of the training parachute at a velocity of 100-120 km per hour may be regarded as approximately 1 second. The employment of a cover for the canopy at the speeds mentioned increases the time of the drawing out by half a second.

When we have opening of the parachute without the employment of the cover of the canopy, we often observe cases of the tearing away of the pilot parachute. Let us consider the cause of this. At the moment when, under the action of the pilot parachute, the canopy and shroud lines of the parachute are completely drawn out, the character of the movement of the pilot parachute changes sharply. The weight of the body of the parachutist from this moment lies entirely on the pilot parachute. The addition of the weight of the parachutist moving at considerable speed causes a sharp increase in the speed of movement and load on the parachute. As a result of this a shroud line is usually torn from its fastening to the bridle of the canopy, the strength of which amounts in all to 100 kg.

But, the breaking away of the pilot parachute does not exert any influence upon the operation of the parachute, because this breaking away takes place after the pilot parachute has performed its function. Even at the pilot parachute does not break away, then, after the filling of the canopy of the parachute it does not function at all, but falls into the "aerodynamic shadow" of the canopy.

THE FILLING OF THE CANOPY

The canopy of the parachute when pulled out forms a "sleeve" with numerous longitudinal folds.

The next stage of the opening consists in the filling of the canopy with air.

The air, going into the entrance opening, formed by the lower edge, as a result of great friction against the folds of material loses velocity and at first does not pass to the inside of the canopy. After this, the portion of air entering also losing speed as a result of friction, creates an excess pressure in the lower part of the canopy and the canopy begins to fill from below. This causes an increase in size of the entrance opening, and the more and more air begins to enter the canopy. The filling takes place in this manner until the bulge beginning from below reaches the apex of the canopy, assuming the shape of a sleeve with a continuous opening for the passage of the air. Starting from this moment, the air coming into

the canopy passes to the inside of it up to the very apex, and the loss of velocity by it takes place gradually over all the path. Since the maximum loss of velocity takes place in the upper part, there is created at this place the maximum excess pressure. As a result of this, the upper part of the canopy at this moment is expanded more than the lower. The filling takes place until the air, constantly coming in through the enlarged entrance opening, unfolds completely all the surface of the canopy.

The time during which the filling of the canopy of the parachute takes place is called the time of filling, and the path travelled by the parachute during this time along the trajectory is called the path of filling. The greater the velocity of movement of the parachutist at the moment of the beginning of the filling of the canopy, the shorter the time of filling will be, all other conditions being the same, because in each unit of time there will go into the canopy of the parachute a greater volume of air.

In reality this volume is the product of the area of the entrance opening and the velocity. It is evident that an increase in the dimensions of the surface of the parachute will cause an increase in the time during which its filling will take place at a given velocity. An increase in the weight of the parachutist or of the load that is dropped also causes an increase in the time for filling, because in this case it will be more difficult for the air entering to straighten out the entrance opening.

The air, coming through the entrance opening, does not all remain in the canopy of the parachute. This is explained by the fact that the surface of the canopy is made of a fabric permeable for air and in a number of cases has an apex vent. With an increase in the size of the apex vent and the permeability of the fabric for air the time of thefilling will be greater. If the dimensions of the apex vent are made a great deal larger, then during the filling of the canopy there may be created a situation such that as much leaves as enters and the canopy will not be filled.

Tests have shown that for a parachute having the form of a flat circle and made of fabric having permeability for air of not more than 100 liters to the square meter per second, the canopy of the parachute will not be filled if the diameter

of the apex vent is made equal to 0.25 of the diameter of the canopy of the parachute. It is necessary to note that the canopy, after being filled to some extent with the aforementioned apex vent, subsequently does not lose its form, that is, it does not fold. This circumstance has great practical significance, because it enables us to determine with what kind of tear (or gap) on the surface of the canopy there will take place a substantial increase in the speed of descent. Experiments with models of parachutes in a wind tunnel have shown that the surface of the parachute loses its shape (folds) if the ratio of the diameter of the apex vent to the diameter of the canopy of the parachute is equal to 0.7. Up to now, these results have not been verified in actual practice.

The path travelled by the canopy of the parachute along the trajectory in the process of filling does not depend upon the speed at which the opening takes place but on the density of the air. For each given parachute it is a constant value. With an increase in the permeability of the fabric for air or the dimensions of the canopy, the path of filling increases. For example, the path of filling of the main training parachute is equal to 30 meters, and of the emergency (reserve) parachute 24 meters. It is necessary to note that the process of filling of the parachute takes place in separate cases in an abnormal manner because of incorrect folding, twisting of the canopy and its shroud lines when they are drawn from the pack and for a number of other causes which substantially change the time and path of filling.

LOADS APPEARING IN THE SYSTEM OF THE PARACHUTE DURING OPENING

Every parachute may be regarded as a brake, the purpose of which is to reduce the velocity of the moving load. And since this is true, then in passing from one velocity, the one at which the jump is made, to another one that is safe for descent and in practice is equal to about 4-6m/sec, a man during the filling of the canopy of the parachute experiences some degree of overloading.

Let us consider the action on the parachute of the forces during the filling of the canopy assuming that the load and the parachute at the given moment move vertically.

Having directed the vertical axis upward as shown in figure 18, we may write, in accordance with the well-known statement of mechanics, that at any given moment of movement the algebraic sum of the external forces and the force of inertia acting upon the body are equal to 0, that is,

$$G + mj - R = 0$$

where R is the composite force of resistance,

G, the weight of the load and the parachute;

mj, the force of inertia.

Since the force of gravity G (the weight of the load with the parachute) is directed downward, the force of braking R is directed upward, and the force of inertia mj is directed downward, opposite the force of braking (figure 23) we obtain:

$$R = G + mj$$

From this equation we can see that the value R (the force of braking) depends on the variable value j, and the remaining values ——the weight and mass of the body——are constant values for each separate case. j is the value of the change (deceleration) in the velocity in a unit of time and is measured in m/sec^2.

In order to get an idea of the value j and accordingly of the value of R, we shall consider a concrete example.

The parachutist actuated the parachute, when the velocity of it was equal to V = 58 m/sec. The weight, G = 100 kg. The time for braking from the moment of beginning of the filling of the parachute until the time that the body acquires a velocity $V_{ш}$ = 6 m/sec was T= 2 sec.

It is required to find the average value of the force of braking:

$$R_{ср.} = G + mj_{ср.},$$

where m is the mass of the body, equal to the weight of the body, divided by the acceleration of gravity g = 9.81 m/sec^2. For our example:

$$m = \frac{G}{g} = \frac{100}{9.81} \approx 10 \frac{kg \times sec^2}{M}$$

j is the retardation of the velocity in a unit of time:

$$j_{cp} = \frac{V_0 - V_{CH}}{T} = \frac{58 - 6}{2} = 26 \text{ m/sec}^2$$

cp = average
CH = velocity of descent

By substituting in the formula the values obtained for m and j, we obtain the average value R_{cp} of the forces of braking:

$$R_{cp} = G + mj_{cp} = 100 + 10 \times 26 = 360 \text{ kg}$$

The true value of the force of braking (dynamic load) will be approximately twice greater than that calculated, however, even the average force of braking is 3.6 times greater than the weight of the parachutist with the parachute.

From the example analyzed, it is not difficult to show that the value of the dynamic load depends upon j, which in its turn depends on V_0 --the velocity of the body at the moment of the beginning of the filling of the canopy -- and T -- the time of braking.

The greater V_0, the greater will be j and, consequently, the greater R--the value of the dynamic load (if the intervals of time considered are smaller, that is, equal to 0.1 sec or still smaller, and if we calculate the corresponding change of velocity during this short interval of time, then we obtain a value of j closely approximating the true value.)

The smaller the time of braking T, the greater the value of R.

This explains why during the opening of the parachute with a smaller surface area, other conditions being equal, the dynamic load will be greater than in the case of a parachute with a large area. For example, a parachute with S = $20m^2$ when opened at a velocity of 200 km/hr showed a maximum dynamic load of 900 kg, whereas under these same conditions a parachute with S = $57m^2$ showed only 500 kg.

A parachute with a large area is filled more slowly, the time of braking is greater, the baking of it is smooth and the load obtained is not great. A parachute, however, with a small area of surface opens quickly, the braking of it is more abrupt and the load is greater.

THE DYNAMIC LOAD ON THE PILOT PARACHUTE

The pilot parachute experiences the maximum dynamic load at the moment of the complete pulling of the canopy and the shroud lines of the main parachute. At this moment, the pilot parachute opens completely and feels a force of braking equal to the force of resistance offered by all of its surface to the moving body (the drawn out canopy and the shroud lines of the main parachute at this moment are connected only by the link between the pilot parachute and the body of the man).

The force of resistance of the pilot parachute will be equal to:

$$R = \rho_h C_{II} S V_0^2,$$

where ρ is the density of the air at the height h where the opening of the parachute takes place;

C_{II} is the coefficient of resistance of the pilot parachute, reffered to the surface S;

S, the area of the pilot parachute;

V_0, the velocity of the body at the moment of the pulling of the main canopy and the shroud lines.

Let us suppose that the opening of the parachute takes place at a height of h = 3000 m, the area of the pilot parachute S = 0.6 m^2, the coefficient of resistance C_{II} = 0.45 and the velocity of the body V_0 = 58 m/sec.

By substituting these values in the formula given above, we obtain:

$$R = 0.1134 \times 0.45 \times 0.6 \times 58 \times 58 = 103 \text{ kg}.$$

Since the strength of the shrouds fastening the pilot parachute to the canopy is not over 100 kg, it is natural that with the opening of the parachute at velocity V_0 from 180 km/hr and above the shroud lines fastening, and with it also the pilot parachute, will be torn loose.

In Table 10, we give the values of R_{cp} for different V_0 depending upon the time during which there is a change of velocity from V_0 to V_{CH} for velocities from 100 to 400 km per hr.

Table 10

t_{sec}	R_{op} with velocities of the body at the moment of the pulling out of the main canopy and shroud lines.						
	V_0 = 100 km/hr	V_0 = 150 km/hr	V_0 = 200 km/hr	V_0 = 250 km/hr	V_0 = 300 km/hr	V_0 = 350 km/hr	V_0 = 400 km/hr
0.5	558	832	1,098	1,382	1,666	1,942	2,218
1.0	328	465	598	740	882	1,020	1,158
2.0	213	282	348	419	490	559	618
3.0	175	220	265	312	367	405	451
4.0	156	190	223	259	294	329	363

The value m was taken equal to 10 kg sec^2/m, which corresponds to the weight of a parachute system of 98.1 kg; V_{CH} = 5m/sec.

The value found for the average load gives only an approximate idea of the value of the forces acting on the parachute system.

As a result of the unevenness of the braking, the maximum load may reach values many times greater than the average value.

In Figure 24, we have the curve of the change of R depending upon the time of braking, calculated under the following conditions:

V_0 = 145 km/hr - the velocity at the beginning of filling;

G = 91.5 kg. - the weight of the parachutist with the parachute;

V_{CH} = 5 m/sec - the velocity of descent with the open parachute,

In this case R_{max} = 581.5 kg, whereas R_{op} = 250.5 kg, that is, the value of the maximum load in this case is greater by 2.3-fold than the average.

From the drawing we can see that the load acting on the parachute, beginning from the moment of the filling, increases up to a maximum value, after which it decreases and after the passing of a certain interval of time assumes a value equal to the weight of the parachutist with the parachute. With an approximate calculation, in which we disregard a number of factors, we assume that the value of the maximum load corresponds to the moment of the complete filling of the canopy, when the area of resistance assumes the maximum value. In reality, the load reaches the maximum value even before the complete filling of the canopy.

In Figure 25, we have given the change of velocity depending upon the time from V_0 to V_{CH}. The point of bend of this curve corresponds to the maximum value of S (see Figure 24).

We see that after this the canopy is completely filled, the system (parachutist-parachute) still for a certain time continues to move with a velocity V_H, considerably greater than V_{CH}. It is only after the passing of a certain interval of time (approximately the same as that required for the filling of the canopy) that the speed of the system takes on a value equal to V_y.

Hence, it follows that if in executing a jump from a low height, the parachute is fully open at the moment of the contact of the parachutist with the ground. This still does not assure safety in landing, because the velocity at this moment will still be much greater than the safe velocity.

Hence, the safe height of a jump will be greater than the height which the parachute loses from the moment of the pulling of the ring until the complete opening of the parachute.

It is now clear why, with a definite average load on the parachute, we took not the time of the filling but the time of the breking. The time during which there takes place a change of velocity from V_0 to V_{CH} is greater than the time of filling.

The load appearing in the system of the parachute upon opening may be calculated or measured by means of a dynamometer or accelerograph.

Figure 26 shows the curve of the maximum load acting on the parachute depending upon the velocity V_0. The load was measured by means of a spherical dynamometer by the release of a parachute with a dummy weighing 80 kg.

We see that, with an increase in velocity, the load on the parachute increases sharply. This is explained not only by the increase in the velocity itself but also by the decrease in the time of filling. Hence, with an increase in the speed at which the functioning of the parachute takes place, the operating conditions of the parachute are greatly worsened.

Since a speed of 400 km/hr and more has become common for present day airplanes, the basic problem at the present time is the creation of conditions for the opening of the parachute such that the loads acting on the parachute and on the parachutist will not exercise harmful influence upon the organism of the man.

We know that the parachutist can withstand excess loads up to 16-fold, acting over a period of 0.2 to 0.4 seconds, and hence, the parachute can be opened only at velocities that are fully determined for the given parachute.

For example, we shall point out that the sport parachute can be opened at actual velocities up to 200 km/hr, and in this case the overloading is nor more than 10-fold, which corresponds to a loading of 1200 kg when the weight of the parachutist and parachute equals 120 kg.

The data given show that the sport parachute can be opened in a "forced manner" (by a rip cord) only at speeds of the airplane up to 300 km/hr. In the execution of a jump with such a parachute from an airplane greater than 300 km/hr, one must not open the parachute until several seconds after leaving the airplane, that is, one should execute the jump with delayed opening of the parachute.

The time of delayed opening should be such as to ensure the reduction of the velocity to that permissible for the given parachute.

METHODS OF REDUCING THE LOAD ACTING ON THE PARACHUTE WHEN IT OPENS

Above, we found that the excess load acting on the parachute at the time of opening increases with an increase in the speed at which the opening takes place and decreases with an increase in the time of braking(the value of the load for personnel parachutes may be regarded as constant.) Hence, in order to reduce the excess load acting on the parachute it is necessary either to decrease the speed at which the opening of the parachute takes place or increase the time of the braking of the parachute.

Before starting to explain the methods for reducing the excess loading, it is necessary to make several statements concerning the time of braking.

It has been found that the time of braking depends chiefly on the construction of the parachute, the dimensions of the surface of the canopy, and also the material from which the canopy is made. At the present time we have all the necessary data,

starting from the requirements made of a given parachute, for giving the most appropriate braking time, which is often that of opening. But we should remember that the increase in the time of braking has its limits. This limit is the safe minimum height of the jump.

Since the parachute should be (within the possible limits) a universal means of rescue, the constructor has to meet, in designing the parachute, two contradictory requirements: on the one hand, to increase the time of braking for reducing the excess loading when the parachute opens at high speeds, and, on the other hand, to conserve the required safe height of jump when the parachute opens at a low speed.

DECREASING OF THE DYNAMIC LOAD ON THE PARACHUTE BY MEANS OF SPECIAL SHOCK ABSORBERS

One of the methods for reducing the excess overloading consists in the employment of different kinds of shock absorbers. The shock absorber, depending upon its construction, may be placed either in the suspension system or simultaneously, also in the suspension system and in the shroud lines.

The absorption of the work done by the parachute in opening is done either by the action of the forces of friction, or by the destruction of the shock absorber itself.

It is clearly obvious that the shock absorber will be all the more effective the more work it absorbs during in the time of the opening of the parachute. With a given force of destruction or friction of the shock absorber, the effectiveness of its action will be proportional to its length. As a rule, however, the introduction of the shock absorber increases the path and, consequently, also the time of braking.

Assuming that all the work done by the parachute during braking is absorbed by the shock absorber, let us determine the necessary length of it under the conditions when the load acting on the system of the parachute over all the time of braking will not exceed the permissible.

The necessary length of the shock absorber is determined from the equation:

$$\frac{m}{2} \left(V_0^2 - V_{CH}^2 \right) = R_{per.} h,$$

per.= permissible

where h is the length of the shock absorber in meters:

m, the mass of the system of the parachute and load;

V_0 , V_{OH} - the velocity at the beginning and end of braking respectively.

Assuming:

$$R_{per.} = 700 \text{ kg.}$$

$$m = \frac{10 \text{ kg. x sec}^2}{\text{m}}$$

$$V_{OH} = 5 \text{ m/sec,}$$

let us determine the necessary length of the shock absorber for different values of V_0. The results of the calculations are given in table 11.

Table 11

V_0 , km/hr	100	150	200	250	300
h_m	5.34	12.2	21.8	34.3	49.5

From this table we can see that in order, with the help of a shock absober, to secure a load of 700 kg (with the assumption given above, on the parachute during opening, the length of the shock absorber for a velocity, for example, of 300 km per hour should be 49.5 meters. An increase in the velocity makes necessary an increase in the length of the shock absorber. But, in practice shock absorbers of such length are not required, because a part of the work is absorbed on the path travelled by the parachute up to the moment of the filling of the canopy, and also by the deformation of the parachute system itself. However, if we assume that even one-half the work done by the parachute will be absorbed by means other than the shock absorber, still the remaining part of it done during the opening of the parachute at maximum speeds requires a shock absorber of excessive length.

We must suppose that even the most effective shock absorbers (with minimum dimensions in weight), with the practical possible length of them, will not make possible an increase in the range of speed at which one can safely employ the parachute to more than 250 km. per hour.

REDUCTION OF THE LOADS BY INCREASING THE PERMEABILITY OF THE FABRIC FOR AIR

An increase in the permeability of the canopy fabric for air allows a considerable part of the air entering the canopy during the filling to escape to the outside. As a result of this, the time and path of filling are increased, and by means of this we have a decrease in the load during opening, and also an increase in the stability of the parachute. The latter is explained by the fact that with an increase in the penetrability the flow of air over the surface of the parachute becomes smoother. However, an increase in the penetrability for air beyond a certain limit is not favorable, since it causes a sharp decrease in the coefficient of resistance of the parachute and, consequently, makes it necessary to increase the surface of the canopy.

REDUCTION OF THE LOADS BY CHANGING THE CONSTRUCTION OF THE CANOPY

It is clearly obvious that without changing the density of the fabric or even the form of the canopy we can increase the time of filling (and this also means the total time of braking) by increasing the diameter of the apex vent or by giving to the canopy additional openings. This makes it possible for a part of the air coming into the canopy during the filling through the entrance opening to escape freely to the outside. But, it is necessary to bear in mind that an increase in the total area of the openings beyond a certain limit, for reduction of the dynamic load, as a rule leads to an increase in the speed of descent of the parachute. In order to avoid this, we usually provide in the construction of the parachute some special flaps for closing the opening after the filling of the canopy, operated either automatically or by means of a central shroud line, fastened by the lower end to the suspension system. A common weakness of all these constructions is the decrease in the reliability of the parachute, caused chiefly by the imperfection of the arrangements for control of the flaps due to the twisting of the shroud lines and the canopy during filling.

REDUCTION OF THE LOADS BY THE SELECTION OF THE MOST FAVORABLE CONDITIONS FOR ACTUATING THE PARACHUTE

Let us consider now whether or not we can achieve a reduction in the loads by opening the parachute at the moment when the body of the parachutist has a minimum velocity of movement.

Above, we found that regardless of the speed of the parachutist at the moment of leaving the airplane, after dropping for some time he acquires a critical velocity, which is constant for a given height and which the body acquires after descending 10 to 20 seconds after leaving the airplane. But, how does the velocity of the parachutist change from the moment of leaving the airplane until the moment of the appearance of the critical velocity in those cases when V_0 is greater than the critical velocity?

Calculations show that in the first 5 to 9 seconds after leaving the airplane in horizontal flight the velocity of the parachutist decreases sharply and reaches the minimum value for the given height. After this the velocity increases up to the critical velocity.

Bearing in mind that the sport parachute can be opened at speeds of less than 300 km per hr (83 meters per second), it follows from the calculated data that at heights from 800 meters to 5000 meters in jumps from an airplane in horizontal flight at an actual speed up to 500 km per hour the most favorable time for delayed opening of the parachute would be 5 to 9 seconds.

With less than 5 seconds or more than 9 seconds of time for delayed opening, the velocity of the parachutist may be greater than the permissible one and especially at great heights.

For example, at a height of 2500 meters the parachute weighing 100 kg (the weight of the parachutist with the parachute) will have a critical velocity of 71.6 m/sec, which is the limit permissible for the opening of the sport parachute in a vertical drop.

In order to insure normal conditions for opening of the sport parachute in

jumps from a horizontally flying airplane at actual speeds up to 500 km per hour, it is necessary to open the parachute either after 5 to 9 seconds after leaving the airplane or at a height of 800 to 1500 meters, in the case of jumps from heights of 2000 to 5000 meters.

The opening of the parachute after a delayed opening of more than 9 seconds at heights above 2000 meters results in excessively high loads on the parachute when it opens.

This circumstance is explained by the fact with an increase in height there is a decrease in the density of the air and, consequently, the resistance of the body will be equal to the weight of the body at a greater speed than at a low height. Hence, at great heights with jumps from a fast flying airplane at actual speeds or more than 300 km per hour, the parachute must be opened in 5 to 9 seconds after leaving the airplane, when the speed is the minimum for the given height or not until a low height where the critical velocity of the parachutist is less than the limiting permissible strength of the parachute.

With delayed opening of the parachute, in 5 to 9 seconds, the loss in altitude will be equal to 120 to 400 meters respectively (jumps from airplanes flying horizontally).

SOME OF THE CHARACTERISTICS OF JUMPS WITH DELAYED OPENING OF THE PARACHUTE WITH A COVER OVER THE CANOPY

In contrast to the forced opening (automatic opening) of the parachute with the rip cord, the opening of the parachute after a delay oftentimes takes place during the turning of the parachutist or when the parachutist is in a position with his back downward.

In this case the pilot parachute may sometimes get caught on a part of the body of the parachutist. If the canopy of the parachute does not have a cover and the pilot parachute is connected with the fastening shroud line to the apex part of the canopy, then as a result of the clinging of the pilot parachute, the canopy of the main parachute will be disposed with the apex part downward. Consequently, so long as the pilot parachute is not released from the place where it is caught, the canopy of the main parachute cannot be filled. With the employment of a cover

the pilot parachute is fastened to the upper part of it and, hence, when the pilot parachute catches on something, the canopy of the main parachute comes out of the cover freely and is filled.

Hence, the employment of a canopy cover, for example, in the sport parachute, increases the reliability of its operation, regulates the form of the canopy up to the moment that it begins to fill, greatly reduces the number of cases of lashing of the canopy by the shroud lines in the process of the opening of the parachute, lengthens the time of pulling out of the parachute when it opens (the advantages of the cover for the canopy are mentioned in the work "Aviation Laboratory for 1918", which gives the results of canopy cover tests, proposed by the balloonist N. Anoshchenko).

In addition to this, the employment of the cover, by increasing the time of the pulling out of the canopy and the shroud lines of the parachute, leads to a decrease in the load on the parachute, especially at low heights.

DESCENDING WITH AN OPEN PARACHUTE

After the complete filling of the canopy of the parachute with air, the system (parachutist-parachute) descends in the air at a vertical speed established for the given height. The force of resistance of the air acting on the canopy is equal to the weight of the system, the acceleration is equal to 0, and the system moves or descends at a constant vertical velocity.

Upon approaching the surface of the earth the density of the air increases, as a result of which the vertical velocity of descent decreases. In case of a calm, weather without wind, the vertical velocity of descent is equal precisely to the velocity of landing of the parachutist by parachute.

In case of descent with a sport parachute under standard atmospheric conditions, the vertical velocity of landing is equal to 5m/sec with a system weighing 120 kg (the weight of the parachutist, main and emergency parachutes).

Since the air is very rarely in a state of rest or calm but most often is in movement (wind, ascending anddescending currents), the velocity of descent and landing very often differ substantially from the vertical velocity.

In wind, the parachutist, in addition to his vertical movement or descent in the

air, moves at the same time with the air and, hence, the speed of landing in the wind is always greater than the vertical speed of descent.

For example, with a wind velocity of 8 m/sec, the speed of landing would be not 5 m/sec, as pointed out earlier, but 9.44 m/sec ($\sqrt{8^2 + 5^2} = 9.44$) at a wind velocity of 4 m/sec, the velocity of landing will be equal to 6.25 m/sec etc.

Hence, the velocity of landing is a variable value and depends on the velocity of the wind on the ground.

In addition to the wind, the ascending and descending currents of air also exercise an influence upon the velocity of landing. The ascending currents reduce the speed of landing, while the descending currents increase it.

If the velocity of the ascending current is numerically equal to the vertical velocity of descent of the parachutist, the parachutist will hang in the air and move together with the air in the direction of the wind.

In certain cases the velocity of the ascending current may be greater than the vertical velocity of descent; then the parachutist will be lifted upward. For example, if the velocity of the ascending current is 7 meters per second and the vertical velocity of descent is 5 meters per second, the parachutist will be lifted up at a speed of 2 meters per second (7 - 5 = 2).

Hence, the most gentle landing will be with ascending currents of air and the most abrupt will be with descending currents. In the latter case the vertical velocity of the parachutist and the current of air are combined.

Consequently, the velocity of landing of the parachutist with the parachute is a value that varies and depends on the velocity of the wind, on the velocity and direction of the vertical currents of the air and on the condition of the atmosphere.

On a hot summer day the vertical velocity of descent will be greater than in the wintertime. This is explained by the decrease in the density of the air with an increase in temperature and with an increase in the density of the air with a drop in the temperature. Hence, in the wintertime one can land with a parachute more easily both because of the snow cover and because of the decrease in the vertical velocity of descent.

In addition to this, the velocity of landing depends on the constructional

characteristics of the canopy of the parachute.

For example, the stabilizer of the canopy of the sport parachute creates additional horizontal displacement of the parachutist in the air, and consequently, increases or decreases the velocity of landing depending upon the position of the stabilizer relative to the wind.

During the descent a part of the air flows from the canopy through the stabilizer, as a result of which there is exerted on the side of the canopy opposite the stabilizer a reactive force which moves the canopy and with it also the parachutist in a horizontal direction. The magnitude of the reactive force depends only on the vertical velocity of descent of the parachutist and the dimensions of the stabilizer, The greater the vertical velocity and the dimensions of the stabilizer, the greater the reactive force.

If the stabilizer of the canopy is set against the wind, the action of the reactive force coincides with the direction of the wind and the horizontal velocity of the displacement of the parachutist with the parachute is increased and this means that the velocity of landing is also increased.

Another situation is created if the stabilizer of the canopy is set with the wind. In this case the reactive force will act against the wind and reduce the horizontal velocity. As a result of this the velocity of landing will be reduced.

Hence, the presence of the stabilizer in the canopy, set in a definite position, may lead to a decrease or increase in the velocity of landing, and to an increase or a decrease in the distance of removal of the parachutist from the selected place of landing.

Hence, the presence of the stabilizer makes it possible to control the canopy of the parachute in the air and this distinguishes in a fundamental manner the movement of the parachutist in the air from the flight of a balloon.

A balloon is moved together with the air, as the wind carries it. The parachutist, by skillfully creating and employing thereactive force of the air, flowing from under the canopy, can move in the desired direction.

By pulling one side of the canopy downward with the shroud lines, the parachutist makes it possible for the air to flow out from under the canopy and under the action of the reactive force, it starts to move to one side. For moving forward, it

is necessary to pull the front part of the canopy; for moving backward, it is necessary to pull the back part. One should bear in mind that a very strong pulling of a part of the canopy downward leads to a decrease in the area of resistance of the canopy and, consequently, to an increase in the vertical velocity of descent, that is, to a decrease in the time of stay of the parachutist in the air. The result of the latter may be that with strong pulling of the canopy the parachutist will land at the same place as he would have with normal movement influenced by the wind.

Example 1. The parachutist descends from a height of 500 meters in 100 seconds. During this time, with a velocity of the wind of 6 meters per second, the parachutist is carried in the direction of the wind to a distance of 600 meters (6 x 11 = 600).

Example 2. The parachutist descends from this same height, but with pulling of the sides of the canopy in the direction of movement. As a result of the increase in the vertical velocity of descent, the time of descent is 50 seconds. During this time the parachutist is carried 300 meters - due to the velocity of the wind (6 x 50 = 300) and 200 meters due to the reactive force (4 x 50 = 200). The total drift will be 500 meters, that is, less than the first place.

An irregular displacement of the air leads to an unstable descent of the parachutist, to a descent with swinging.

But, in addition, to the displacement of the air (wind, descending and ascending currents), the special constructions of the canopy of the parachute also exert an influence upon the character of the descent.

For example, an increase in the permeability of the fabric to the penetration of air, a change in the form of the canopy, etc. insure a stable descent. But, with gust wind, descent on the edge of a field or forest or a surface of water, the most stable kinds of parachute canopies will begin to swing, together with the parachutist.

At great heights, the air shifts at a greater velocity, and hence, the descent of a parachutist at great heights takes place was a rule with a great deal of swinging, with subsequent attenuation of the swinging as one approaches the ground.

Descent on Two Canopies

The vertical velocity of descent of a parachutist with an open parachute depends upon the area of the surface of the canopy. This dependence is expressed by the formula:

$$V_{CH}^2 = \frac{2G}{\rho C_{II} F_{II}},$$

or

$$V_{CH} = \sqrt{\frac{2G}{\rho C_{II} F_{II}}},$$

where V_{CH} is the vertical velocity of descent;

G, the weight of the parachutist with the parachute;

P (Rho), the mass density of the air at the height of descent;

C_{II}, coefficient of resistance of the canopy

F_{II}, area of the surface of the canopy.

Since the weight of the given parachutist is a constant value, then, assuming C_{II} and P to be constant, we obtain:

$$F_{II_1} V_{CH_1}^2 = F_{II_2} V_{CH_2}^2 = \text{const.}$$

From what has been given it follows that with an increase in the area of the parachute the velocity of descent is reduced and is equal to:

$$V_{CH_2} = V_{CH_2} \sqrt{\frac{F_{II_1}}{F_{II_2}}}$$

Let us consider an example.

A parachutist descends at a velocity of $V_{CH} = 5$ m/sec on the canopy of a parachute having an area of $F_{II} = 70$ m^2.

It is necessary to determine the velocity of descent of a parachutist on two canopies: the main and the emergency, if the area of the canopy of the reserve parachute is equal to 42 sq. meters.

The total area of the two canopies: $F_{II_2} = 70 + 42 = 112$ m^2.

Then the velocity of descent on two canopies will be equal to:

$$V_{CH_2} = 5 \sqrt{\frac{70}{112}} = 3.97 \text{ m/sec}$$

In reality, the velocity of the vertical descent on two canopies would be greater than that shown (3.97), due to the fact that the canopies are disposed under a certain angle to the vertical and, hence, not all of the area of the canopies participate in the resistance but only their projection on the horizontal plane.

The greater the camber between the canopies, the less will be the projection of the area and the less will be the influence of the additional canopy on the velocity of the descent.

If the canopy is arranged with the shroud lines close up to each other, the total area of the projection of the canopies will be equal to 90 sq meters, and the velocity of descent will be 4.4 meters per sec.

In reality, between the shroud lines of the canopies there is some camber and, hence, the total area of projection will be less than 90 sq meters and the velocity of descent will be greater than 4.4 meters per second but less than 5 meters per second.

What has been explained above shows that the opening of the reserve parachute reduces only to a small extent the vertical velocity of descent, but increases the stability. Hence, descent with two canopies facilitates landing by a slight reduction in velocity and stability of descent.

CHAPTER III

THE PARTS OF THE PARACHUTES AND THE PACKING OF THEM

General Information Concerning Parachutes.

In the aero-clubs and educational institutions of the Dosaaf, for carrying out the instruction-training and sport jumps, use is made of training parachutes with canopies having a circular shape of the types PT-1A, PD-6, PD-6R, and of a canopy of a square shape in combination with reserve parachutes.

As rescue parachutes, the Dosaaf organizations employ parachutes of the type PL-45 and others.

Parachutes are subdivided on the basis of their employment into rescue and sport-training parachutes; on the basis of purpose, into personnel and cargo, on the basis of the method of opening, into parachutes of forced opening(static line) and parachutes of free opening(by hand).

Parachutes of forced action are opened by means of a static line, fastened by one end to the opening device of the parachute, and by the other end to the seat of the aviator(brackets, cable of the airplane, basket of the cabin of the balloon etc).

Jumps with a parachute of forced opening are subdivided into jumps with a parachute of forced opening of the pack of the parachute and with the employment of "snatch" lines or forced pulling away of the cover of the canopy and into jumps with a parachute of forced opening of the pack of the parachute and with employment of a pilot parachute.

In case of jumps with a parachute of free action, the parachutist himself opens the pack by means of a rip cord ring. The canopy with shroud lines is pulled from the pack by the pilot parachute.

On parachutes of free action we employ a semi-automatic device as a matter of precaution.

Rescue parachutes are intended for the rescue of passengers and crew in case of damage to aircraft in the air. In all cases, when for any reason a real danger to life appears the crew members should immediately abandon the airplane and save themselves by parachute.

Rescue and sport-training parachutes, on the basis of principle of construction and operation, are basically the same. They differ only in the dimensions of the

canopy, the velocity of descent and the place of fastening the parachutes to the suspension system. In addition to this, the sport-training parachutes are employed only in the presence of a reserve parachute(the latter is intended for use in case of a failure of the main parachute.

The cargo parachutes are to be used for dropping different kinds of loads in cases when the landing of the airplane is not required or is impossible.

THE BASIC REQUIREMENTS MADE OF PARACHUTES

A parachute should be able to support the load which it receives when it opens 3 to 4 seconds after the parachutist leaves the airplane, and in constructions it should be simple and convenient to employ. The parachutists should be able to jump from any point of the airplane and when the airplane is in various positions in the air, easy for the execution of side slipping and in the case of parachutes having square canopies it should also be easy to turn the stabilizer on the proper side.

The velocity of landing of sport-training parachutes should not exceed 5 meters per second, and for the rescue parachutes, not over 7 meters per second. The rescue parachute should not weigh more than 8-10 kg and the sport-training, not more than 14-20 kg.

The parachute should have an elastic suspension system uniformally distributing the load received at the time of the opening of the canopy, should not interfere with movement in the airplane, making it possible to assume a comfortable position in the air, and also a construction making it possible to free oneself quickly from the suspension system upon landing. The suspension system should also fit properly to the parachutist in accordance with his height and kind of uniform.

The opening device should be simple in construction, faultless in operation and convenient to operate.

Lastly, it is necessary that all the parts of the parachute have sufficient reserve strength.

SPORT TRAINING PARACHUTES WITH A CANOPY HAVING A CIRCULAR SHAPE

Sport-training parachutes with a circular canopy are employed for making instruction-training and sport jumps from an airplane or other aircraft.

When the trainee uses the parachute, he places the pack of the canopy(figures 27,28, and 29) on his back. The parachute has two devices for opening: the forced and the manual, acting independently of each other. The manual and the forcing

device may be mounted for simultaneous action.

The weight of the parachute is 14 kg(without the carrying bag).

The parachute is used for forced jumps in combination with the reserve parachute. Both canopies open independently.

For manual opening of the main parachute there is a rip cord ring placed on a circular strap of the suspension system on the left side even with the chest.

The canopy of the sport-training parachute is for the descent of the trainee, the reserve, however, is employed in cases of complete or partial failure of the sport-training parachute canopy to open, when the velocity of descent increases in a manner that is not customary and does not provide for normal landing. The reserve canopy of the parachute is also opened for a special task(sic).

In all cases of jumps from an airplane or other aircraft, one first opens the canopy of the sport-training parachute. It is categorically forbidden to open first the canopy of the reserve parachute and then the canopy of the sport-training parachute. (Hereinafter, for simplifying matters we shall call all sport-training parachutes, both those with a circular canopy and those with a square canopy, basic parachutes.)

The canopy of the main parachute is completely opened with not more than 3 seconds from the moment of the pulling of the rip cord ring.

With a total weight of trainee nf not more than 100 kg, the velocity of landing with the main parachute does not exceed 5m/sec. and with the reserve parachute, under these same conditions, not more than 7m/sec.

The parachute can be employed for practice-training jumps or sport jumps from an airplane at a speed of flight(instrument flying) of up to 225 km/hr.

The parachute consists of a canopy with shroud lines, pilot parachute, suspension system, pack, the pull ring of the rip cord, bag for storing and carrying the parachute and the parachute "log"(service list).

The Canopy of the Parachute with the Shroud Lines

The canopy of the parachute has in ground-plan the shape of a circle and is made of cotton (percale and silk fabric. Its area is equal to 60.3 m^2(Figure 30). Around the perimeter, the canopy has a reinforced edge, called the lower selvage, consisting of a semi-silk or cotton tape 25mm wide on the inside.

In the center the canopy has an apex vent having a dimension of 445 mm.

The edge of the apex vent is reinforced by placing on it a semi-silk or cotton tape 25 mm wide. It is called the upper selvage.

The canopy is made by sewing together 28 trapezoidal panels, inscribed in a circle having a diameter of 8.76 m. On one of the panels, near the lower selvage, there is placed the factory mark. The panel with the factory mark is conventionally called the first. The further counting of the panels is done around the circle counter-clockwise.

Each panel consists of 4 Vee-shaped pieces. The first Vee-shaped pieces(at the lower selvage) are silk, and the rest are percale. The panels and the Vee-shaped pieces are joined by a lock stitch and are stitched by parallel seams, the panels by four and the Vee-pieces by two.

The seams between the panels are called radial, and those between the Vee-pieces are called diagonal or transversal.

The counting of the Vee-pieces in the panels is done from the lower selvage towards the apex vent.

In the diametrally opposite placed seams of the canopy there are placed 14 cotton cords, which, crossing the apex vent, form the so-called apex "bridle".

The cords, extending out from the radial seams at the lower selvage of the canopy form the loose ends of the shroud lines to the number of 28, which are fastened by a special knot to the semi-rings of the loose ends of the suspension system and are stitched by zig-zag stitches.

The resistance to tear of the cotton shroud lines is equal to 125 kg.

Along the radial seam, each shroud line is stitched to the canopy by a zig-zag stitch in 4 places as follows: near the lower and upper selvage and in 2 intermediate places. At the lower selvage, to give strength to the fastening of the shroud lines there is placed an additional reinforcement.

The length of the shroud lines is measured from the lower edge of the canopy to the semi-ring(D-ring) of the loose ends of the suspension system and should be equal to 6.45-6.65 meters, and the difference in length of the seperate shroud lines should not exceed 70 mm.

The counting of the shroud lines is done along the lower selvage of the canopy, counterclockwise. The shroud line which is between the 1st and 2nd panel is called the first shroud line.

Since the packer of the canopy starts with the 14th shroud line, one places on it near the selvage of the canopy an identification patch made of percale of an orange color.

THE PILOT PARACHUTE

For pulling out the canopy and the shroud lines of the parachute after the opening of the flaps of the parachute pack, we employ a pilot parachute. It consists of a canopy with shroud lines and a spring mechanism(Figure 31).

The canopy of the parachute is square shaped and made of silk; it has an area equal to 0.77 square meters. The length of the sides of the canopy is 887 x 887mm.

For strengthening on top the canopy is reinforced by four 13mm cotton tapes, and the lower selvage of it is reinforced by a double fold of fabric on the outside with subsequent stitching with 2 parallel stitches. The canopy has 8 shroud lines. All the shroud lines are fastened at one end to the tape "frame" and the lower selvage of the canopy, by a zig-zag seam, and the other ends are placed in the thimble, wrapped with waxed linen thread. The shroud lines are made of silk cord having a strength of 50 kg.

The length of the shroud lines from the lower selvage to the plaited thimble is 750mm.

On the inside of the canopy there are sewed to the "frame tape" 4 pockets of 13mm cotton tape for the placing of the spokes of the spring mechanism.

The spring mechanism serves for the opening of the canopy of the pilot parachute and consists of 2 pairs of spokes and a small box, fastened by 2 supports. Each pair of spokes, at their middle part, is wound on a cylindrical spiral spring. One pair has a cylindrical spiral with a diameter of 33.5 m and 3 coils, and the second has a cylindrical spiral with a diameter of 13.5 mm and 5 coils.

The spring with the small diameter of the spiral is placed in the spring with the large diameter. Both are connected with each other by a metallic box, fastened as 2 halves with 2 supports. The ends of the spokes are rounded and covered with insulation tape to protect the fabric of the canopy from being pierced by the spokes.

For protection against corrosion, the spring mechanism is zinc or cadmium coated. At the places of the intersection of the reinforcing tape, the spring mechanism is fastened to the canopy with waxed linen threads.

The spring mechanism forces the opening of the canopy of the pilot parachute immediately after the opening of the flaps of the pack of the parachute.

The pilot parachute is connected with the bridle of the canopy of the parachute by the pull shroud having a length of 350 mm, and a resistance to tear of 80 to 100 kg (silk cord No. 12).

The pilot parachute is employed if the parachute is arranged for manual opening. If the pulling out of the canopy of the parachute and the shrouds from the pack takes place with the aid of the pull cord, the pilot parachute is untied.

SUSPENSION SYSTEM(HARNESS)

The suspension system serves for fastening the parachute to the parachutist. Its elastic construction makes possible uniform distribution over the body of the parachutist of the load received at the moment of the opening of the parachute.

It does not interfere with the movement of the parachutist, gives him an opportunity to assume a comfortable position in the air while descending and landing, to control the parachute during the descent and to quickly release himself from the suspension system at the time of landing(Figure 32).

The suspension system is made of semi-silked webbing having a width of 44mm and a resistance to breaking of not less than 1,100 kg. It consists of a main circular strap, 2 back-shoulder straps and 2 leg straps.

The main circular strap is sewed in two folds and at the places of branching forms 4 loose ends, to which are sewed the semi-rings(D-shaped buckles). To each of the semi-rings there are fastened 7 shroud lines of the canopy of the parachute.

The main circular strap, by means of 2 curved shoulder buckles, mounted on the main circular strap, is connected with the back-shoulder straps in the upper part of the suspension system.

Two back-shoulder straps, with their sloping ends, are sewed to the main circular strap, fastened to each other on the back by a cross piece, pass through the curved shoulder buckles, form a chest cross-piece and pass into the belt opening of the main circular strap. With the aid of 2 rectangular buckles, sewed to the other ends of the back-shoulder straps, there is formed a waist strap.

The leg straps, sewed to the main strap, also have rectangular buckles for the adjustment of the leg straps to the height and the uniform.

After the suspension system is put on, it is buttoned with the aid of 3 snaphooks and 3 D-shaped buckles, which are on the leg straps of the main strap and on the chest cross-piece.

Two- PZ snaphooks, which are on the main circular strap on a level with the waist, serve for the fastening of the pack of the reserve parachute.

On the line of the chest, on the left side, on the main circular strap of the suspension system, there is sewed a pocket for the pull ring of the rip cord and over the pocket there is the end of the flexible hose for the cable of the pull ring of the parachute.

THE PACK

The pack serves for the placing of the parts of the free ends of the suspension system, the shroud lines, the canopy of the parachute and the pilot parachute. It is made of airplane canvas of a camouflage color which is impervious to water, (Figures 33,34).

In the open form the pack has the shape of an envelope with two long and two short sides. On the long sides there are lateral flaps, on the short side there are the end or terminal flaps. The lateral flaps have 2 supplementary flaps, serving for the separation of the pilot parachute from the canopy of the parachute.

For protecting the canopy from being soiled, the flaps(excepting the lower flap), have corner sub-flaps with pockets.

The pack is given its shape by means of a wire frame which gives rigidity, placed at the bottom(the pack has a double bottom), and by metallic plates in the flaps.

On the bottom of the pack, on its inside, there are fastened two rows of detachable rubber loops("honey combs") for packing in them of the shroud lines of the canopy of the parachute.

The loops("cells") are made of rubber. If they are damaged, they may be replaced immediately at the aero club.

On the outside of the bottom of the pack there are sewed some "coat" loops for the hooks of the rubber bands of the parachute, 4 tape bands for the fastening of the pack to the suspension system and a pocket for the parachute service list.

Eight of the rubber pack bands are intended for rapid opening of the flaps of the pack(3 rubber bands on the side flaps, one each on the upper and the lower flaps) (If we use the semi-automatic parachute devices, we place on the upper flap of

the pack, parallel to each other, two elastic pack straps, which are fastened to the coat loop or to the semi-automatic fastener device sewed to the upper flap). On the ends of the rubber bands of the pack there are hooks. By one end the rubber bands are fastened solidly, by means of hooks(snap hooks) to the coat loops at the bottom of the pack, and by the others--to the hooks sewed to the flaps of the parachute pack. The length of each elastic band of the pack with the hooks is 330-340 mm.

The right lateral flap of the pack has a protective flap which is a prolongation of the lateral flap and is fastened by 4 pairs of buttons, called "tourniquets". For rigidity, a metallic plate is sewed in it. The protective flap covers the closing devices of the pack(pins, cones, and louvers) and protects it against damage.

In the base of the upper flap there are made 2 openings for the exit of the loose ends of the suspension system from the closed pack. The openings have corner flaps with pockets.

To the upper flap there is sewed the end of the flexible hose for the cable of the pull ring of the parachute.

For the forced method of opening the parachute, there is sewed to the upper flap of the pack an additional flexible hose to the right of the main hose with a reinforcing tape of the flap at a distance of 85 mm from the axis of the first cone. The other end of the hose is not sewed. The main hose of the opening devices is also sewed at a distance of 85mm from the axis of the cone.

In making jumps with the manual method of opening, the additional hose is used for forced turning on of the semi-automatic device. If the semi-automatic device is not employed, the hose is dropped under the right loose ends of the suspension system and is placed under the upper elastic pack strap on the right side of the flap of the pack.

The pack of the parachute is closed by means of louvers which are placed on cones and held with pins of the rip cord. On the left lateral flap there are two cones and one louver; on the upper end there is one cone, on the right side flap there are 3 louvers and on the lower end there is a buckle-louver.

THE RING OF THE PILOT PARACHUTE

The pull ring is intended for the manual opening of the pack of the parachute

and consists of the following basic parts: the body of the ring of a trapezoid shape with limiting catch, made of steel wire having a diameter of 7mm, zinc plated, and a cable with 3 pins. One end of the rip cord is passed into the opening of the body of the ring and the limiting catch and has a locking stop for seating the holder, and the other, the loose end terminates in three pins, serving for closing the louvers on the cones, that is, for closing the flaps of the pack. The length of the cord from the end of the last pin to the catch is equal to 1070mm. The ring on the 2 opposite sides has depressions which hold it in the pocket sewed to the suspension system. In order that the parachutist may find the ring quickly at the time of the jump, half of it, projecting from the pocket, is painted a red color(figure 35).

THE CARRYING BAG, THE PARACHUTE SERVICE LIST

The carrying bag is for carrying and storing the parachute. It has a cover which is buttoned and two small handles for carrying. On the cover and sides of the bag there are loops through which, when sealing the bag, we pass a thread. On one of the end sides of the bag there are loops and pockets for tying and keeping the name tag.

The bag is made of aviation canvas. Its dimensions, with the parachute placed in it, are 390 x 265 x 390 mm(figure 36).

The parachute service list is an indispensable part of the parachute. The rules for keeping it are given in the service list itself.

PACKING OF THE PARACHUTE

The packing of the parachute is done in a special, light, clean room--in the parachute classroom. If the parachute is packed outside a building, it is necessary to select for this purpose a level, dry, shady place, free of dust, if possible with a grass cover. The clothing and the hands of the packers should be clean. The packing of the parachutes is done on special tables(or on field panels)(1).

(1) The field panel set consists of the following: a tarpaulin sheet having the dimensions of 13 x 1 meter, four knee pads, five metal spikes for fastening the panel to the ground--one instead of the peg for the canopy-- a lining or base sheet, packing instruments and a bag for packing and carrying the field panel set.

with the help of the packing instruments consisting of a hook, a ruler, sandbags, accessory pins, cords for pulling the flaps of the bag, a base sheet, thread for locking, sealing device and seals (figure 37).

The wooden table, having dimensions of 12 x 1 x 1 meters, should have a polished surface. At the end part of it one fastens a wooden peg(or hook) for attaching the loop of the pull strap of the canopy of the parachute of circular form and the apex loop of the canopy of the parachute of square shape.

The hook is intended for the placing of the shroud lines of the parachute in the coils of the pack. It is made of steel wire having a diameter of 5mm, with a wooden or metal handle. The hook should be polished, its sharp edges smoothed off, so that during the time of the packing it will not damage the shroud lines of the parachute.

The wooden ruler, having dimensions of 430 x 34 x 6mm, should also be carefully polished, and its edge rounded. The ruler is necessary for the packing of the canopy of the parachute into the pack, for the straightening of the flaps in the tightening of the pack and the arranging of the angular openings of the flaps of the pack.

The sand bags are for holding the panels of the canopy in the process of packing. They have the shape of a small pack which is sewed lengthwise,forming two independent compartments. Into these compartments we pour some large-grained, well-washed sand after which we sew up the sack.

The length of the sandbag is 450mm, its width 70mm. For the packing of one canopy it is necessary to have 5 sandbags.

The accessory pins are made of steel wire having a diameter of 2.3 mm with a loop of cable on one end. The pins are for the purpose of preliminary locking of the cones of the pack while packing the parachutes and after the tightening of all the flaps of the pack they are replaced by the pins of the pull cord. For the packing of one parachute we require two pins.

The tie pieces serve for the tightening of the flaps. They are made of silk cord having a length of one meter and a strength of 50 kg. For the packing of the parachute it is necessary to have three tie pieces.

The thread, sealing tool, and seals are for the purpose of locking and sealing the pins of the pull cord of the parachute. The threads are of white cotton, No. 30, or No. 40; for sealing the carrying bag we use linen thread having a strength of 15 kg.

The base panel should be of white baize or some other cotton fabric having a length of 4.5 m and a width of 1.24mm, with a cord having a length of 7m.

Before beginning the packing it is necessary to examine carefully the surface of the table, all the packing instruments and the parts of the parachute. After making sure they are all in good condition we can start the packing.

The inspection and packing of the parachute is done by two men: the packer and his assistant.

The inspection of the parachute is done to determine its readiness for making a jump and in preparing for packing.

The parachute is taken from the bag, stretched out on the table over its entire length and the loop of the pull cord fastened to the peg on the table. Under the parachute we place the base panel, the cord of which is also fastened to the peg of the table. The suspension system is arranged with its loose ends in pairs(figure 38) and with the seams of the semi-ring on the inside. The suspension system should lie on the table just as it would be placed on a man standing with his face towards the canopy and the table(figure 39). The pull ring should be on the left side of the table. The right and left sides of the table are determined on the basis of a man standing at the end of the table where there is no peg(near the pack) and turned with his face towards the apex of the canopy.

The inspection starts with the drawn out parachute, its canopy, spring mechanism, pockets for the "spits"(not identified) and its fastening to the pull cord. If the spring mechanism is out of order, the pilot parachute is replaced.

After this, we proceed to inspect the canopy of the parachute. The packer begins by taking the loose ends of the right and left group of shroud lines of the suspension system; he approaches the canopy and arranges it with the right panel (with the factorymark) upward. During this time the assistant arranges at the apex vent the shroud lines and the edges.

After this the packer takes the 28th shroud line together with the lower edge of the canopywith his right hand, and with his left, passing it along the lower edge, takes the 27th shroud line (the next one in turn) also together with the lower edge, lifts it, tightens and shapes it. In doing this he at the same time checks the condition of the panel and the security of the fastening of the shroud lines to the lower edge. After this the packer changes the shroud line from the left hand

to the right and grasps it with his thumb and index finger, and the panel is folded in halves on the inside. He again takes the next shroud line(the 26th), lifts it, shakes it, inspects the panel, etc. The assistant who is on the right side of the table, simultaneously with the packer inspects and shakes in the same manner the right group of panels until all the canopy has been examined and shaken.(Figures 40 and 41).

After the inspection of the canopy of the parachute, they proceed to inspect its shroud lines. For this purpose the shroud lines are gathered up, placed tightly against each other and stretched. The packer takes up the shroud lines and makes movements with his arms to and from himself. By this means the shroud lines are turned through 360 degrees, making it possible to inspect at once all the shroud lines on the given sector.

Hence, beginning from the lower edge of the canopy one examines all the shroud lines of the parachute.

After inspection of the shroud lines, one inspects the suspension system, and its metallic parts: the seal-rings, the D-shaped rings and the rectangular buckles, snap hooks and their springs. After this one carries out the inspection of the pack, the cones, and the louvers.

It is necessary to pay special attention to the checking of the condition of the louvers, cones and cells. One should also inspect the rubber, the hooks, loops and pull ring. One should carefully inspect the cable to see if any of its threads are torn out, if there are any defects in its fastening to the rings, barbs or rusted places on the pins, plaits, solder of the studs and if the pins are bent. In addition to this one checks the flexible hose, sees if they are properly sewed to the upper end of the flap and the condition of the sewing of the second end of the left hose to the suspension system.

The defects discovered should be corrected. The worn parts should be replaced by new ones, if they belong to the category of those repaired by the aero-club. If they require factory repair, the parachute and the record of its use should be sent to the factory.

After inspection of the parachute, we proceed to pack it. Before doing this it is necessary to place all the packing instruments on the table near the pack, place the tightening cords in the cones, put the rip cord in the flexible hose, and put the ring

in its pocket. The flaps of the pack are tucked under the pack and it is placed on the suspension system so that the terminal flap with the ends of the flexible hose sewed to it will be turned towards the canopy.

The packing of the canopy. The packer takes with his right hand the extreme inside shroud line of the right lower strap near the semi-ring(D-shaped buckle), that is, the 14th shroud line marked by a color sleeve(Figure 42), and separating it from the group of shroud lines, goes up to the canopy, changes the shroud line to the left hand and puts it on the table between the two groups of shroud lines. With the right hand he takes hold of the shrouds of the left half and places them together with the panels on the right side of the table(figure 43 and 44).

After this, holding with the left hand the 14th shroud line at the place of its fastening to the lower edge and, passing the right hand along the edge, the packer takes the next shroud line, lifts it up over the shroud line in the left hand, and by a sharp movement downward puts it on the first(figure 45). The assistant, who is on the right side of the table, gives to the packer the next panel.

In a similar manner one packs on the left side all the fourteen panels up to the panels with the factory mark.

On the packed side of panels, over its whole length, one places the sand bags. The first sand bag should be placed along the lower edge, parallel to it(figure 46).

After this the packer goes to the right side of the table, and the assistant to the left side and start to carry out the packing of the right group of panels, for which purpose they throw this group to the left, on the one that is packed. With the left hand the packer takes the lower, 14th shroud line, of the left group of folded panels(moving it first to the right by 2-3 cm) and with his right hand runs along the edge and takes the next shroud line and lifts it up over the shroud line which is in his left hand, and by a sharp movement downward, puts it on the first (figure 47). In this manner one packs all the remaining panels of the right group.

After the packing of the canopy, the panel with the factory mark should be on the right side, the upper shroud line should run to the inside edge of the upper left strap of the suspension system, and the number of the shroud lines on each side should be the same(Figure 48).

After this the assistant removes the sand bags from the canopy and the packer takes all the shroud lines at the lower edge and pulls them. The assistant, during

this time, straightening the panels and brings the shroud lines over all the length of the canopy up to the middle. The packer, however, who is on the left side of the table and who has placed the palm of the left hand on the shroud line near the canopy, passes the right group of them between the index and middle finger, placing the shroud lines upon each other. With his right hand he pulls and takes up the slack of the shrouds of the right group until the lower edge of the panels comes up close to the fingers of the left hand, after which he presses with them the shroud lines (Figure 49).

After this the assistant, who is on the right side of the table, begins by turns together with the packer to even the edge of the canopy of the right group of panels. After evening the panels of the right group along the lower edge of the canopy, one puts on the weights(or sandbags). By this same method they even the edge of the canopy of the left group of panels(Figure 50). In this the role of the packer is performed by the assistant.

After evening the edges of the canopy, the packer places on it his left hand and bends the left group of panels under an angle of 30-40 degrees towards the lower edge(Figure 51). The assistant, after removing the sand bags, does the same with the right group, so that the width of the base of the folded canopy will be equal to the width of the pack. A reduction or increase of the width of the base distorts the form of the parachute after folding and renders more difficult the tightening of the pack.

The panels of both sides, upon bending, should fold like a fan. Then the packer, and after him also the assistant in turn, bend to the middle the edge of the panels over their length without crumpling them.

On the folded canopy one places the sand bags(figure 52) and again checks the correctness of the arrangement of the panels and the shroud lines after the packing, for which purpose the assistant hold the shroud lines near the lower edge, and the packer passes the ruler under the upper strap and brings it toward the canopy (Figure 53). With correct packing the upper shroud lines should correspond to the upper half of the panels(Figure 54). After doing this, the packer returns to the pack, takes hold of the left and right pairs of straps near the semi-ring(D-shaped buckle), joins them together and evens the shroud lines, pulling them lightly. After this, the assistant removes the loop of the pull shroud from the peg of the table,

places the pilot parachute with the spring mechanism on top on the upper part of the canopy and folds from the two sides along all the length of the edge of the base panel(See Figure 52).

The packing of the shroud lines into the cells of the pack. The packer with his left hand seizes all the shroud lines near the semi-ring(D-shaped buckles) of the straps, pulls them toward the pack and places the straps in pairs at the openings of the pack so that the semi-ring will be between the 4th and 5th cells; the counting is done from the upper end flap(Figure 55).

After this the packer, who is at the end part of the table, bends the bunch of shroud lines around the index finger of his left hand, with his right hand puts the hook in the right lower cell from himself, seizes the shroud lines with the hook from the index finger of the left hand and pulls them into the cells. After pulling the shroud lines up to the edge of the pack, he places the hook in the vertical position and draws the shroud lines with the left hand. Excessive pulling of the shroud lines may lead to damage or tearing of the cells when the shroud lines are pulled from them at the moment of the opening of the parachute.

Having take out the hook cautiously, the packer takes it in his left hand, bends a bunch of shroud lines on his right index finger pulls them to himself to the necessary length, passes the hook into the extreme left lower cell, with the hook takes the loop of the shroud line from the finger and pulls it through the cell. (Figure 56). In the same manner they pack and fill with shroud lines all the remaining cells.

The assistant, with the thumb of one hand, holds the upper cell with the shroud lines placed in it; and holds the pack with the other hand so that it will not move. In the packing of the shroud lines into the cells, one should see that the shroud lines are not slack or twisted. The canopy should be drawn to the pack to the extent required for the packing of the shroud lines. The length of the shroud lines left after packing the cells remaining should not exceed the length of the pack.

The shroud lines placed in the cells of the pack should look like those shown in figure 57.

The packing of the canopy in the pack. The packer takes all the shroud lines at the lower edge of the canopy, removes the first weight and lifts up the canopy,

holding it up with his hand. The assistant places a ruler under the canopy, along the lower edge(figure 57). After this he places the canopy on the pack up to its lower edge, straightening the canopy along the width of the pack. The assistant takes out the ruler and puts it on top of the canopy over the upper edge of the bottom of the pack, and the packer, moving away from the pack to a distance equal to its length, takes hold of the canopy with his two hands(figure 56) and folds it at the same time widening the canopy to the dimensions of the pack. In this manner one places all the canopy of the parachute on the pack. In the process of packing we gradually remove the sandbags from the parachute. The upper part of the canopy with the loops of the pull shroud are tucked in under the upper row of folds of the canopy. The canopy should be arranged uniformly over the whole length and width of the pack so that in the tightening of the pack it will have a regular form with a slight thickness in the middle (Figure 60).

The tightening of the pack and the packing of the pilot parachute. The tightening of the pack is started from the middle cone. The assistant with his two hands presses on the folded canopy, and the packer with his two hands takes hold of the flap for the pilot parachute on both sides, pulls and places it on top of the canopy (figure 61). At this moment the assistant takes his hands from under the flaps and, in his turn, takes on his side the flap for the pilot parachute, pulls it and places it on the same flap of the opposite lying side of the pack(Figure 62). With his right hand the packer puts in the middle louver the tightening cord from the middle cone, and the assistant takes hold of the tightening cord (Figure 63). With his right hand, by means of the tightening cord, the assistant pulls the cone into the middle louver takes the auxiliary pin and with it fastens the middle cone to the face side of the lower flap, leaving the tightening cord in the cone(Figure 64).

After this the packer proceeds to pack the pilot parachute, first arranging with the aid of his assistant the additional flaps of the pack of the pilot parachute. (Figure 65).

The pilot parachute is laid on the table with its spring mechanism upward. After this the assistant, with one hand, lifts up by the thimble the shrouds of the pilot parachute, and, with the other, he takes hold of the middle of the shrouds. The packer, during this time, with two hands presses the points of the spring mechanism. The assistant lowers the shroud lines in such a way that the lower edge

of the canopy will be 2-3 cm above the ends of the points of the spring mechanism, seeing that the canopy of the parachute does not fall into the box of the spring mechanism.

After this, the corners of the parachute are arranged. (Figure 66).

The pilot parachute is placed in the pack from the sides of the upper terminal flap(sewed hose) above the flaps, separating the main canopy from the pilot parachute (Figure 67). For this purpose the assistant lifts the ends of the flaps and the packer places the pilot parachute in such a way that the box of the spring mechanism will reach the edges of the flaps of the pilot parachute. The box of the spring mechanism should be in a horizontal position.

The shroud lines of the pilot parachute are arranged in a zig-zag fashion between the ends of its flaps(on the side of the upper flap). The thimble of the shroud lines with the "pull shroud line" is placed under the lower flap of the pilot parachute.

After the packing of the pilot parachute one pulls the terminal upper flap and then the terminal lower flap.

The tightening cord of the upper terminal flap is done in the following manner.

The packer puts the tightening cord, which is in the cone of the upper end flap, into the louver of the lateral flap. The assistant takes hold of this tightening cord and pulls the cone into the louver, and the packer assisting him pulls the side flap, so that the louver will go on the cone easier, and fix the cone with the auxiliary pin(figure 68). After this we thrust this same tie piece into the louver of the right lateral flap. The packer at this time pulls to himself the right flap, and the assistant places the louver of the right lateral flap on the cone of the upper end flap. After this the packer pulls from the cone the auxiliary pin, and the assistant, pulling the cone with the tie piece upward, places in it the upper pin of the rip cord(figure 69).

After the tightening of the upper end flap, one proceeds to replace the auxiliary pin of the middle cone with the middle pin of the rip cord. For this purpose the packer, pulling the right lateral flap behind the protective flap of the closing device, takes out the auxiliary pin from the middle cone, and the assistant, after pulling upwards on the middle cone with the tie piece, places in it the middle pin of the rip cord(figure 70).

After this the packer places the tie piece, which is in the lower cone of the left side flap, in the lower louver of the right lateral flap and hands it to the assistant, and he pulls to himself the right lateral flap. The assistant puts the louver on the cone and fixes the rip cord with the lower pin(figure 71). After this the packer puts into the louver buckle of the lower flap the strings left in the middle and the lower cones and pulls the louver buckle to the cone. The assistant introduces a ruler under the lower flap and straightens it(figure 72), and the packer, pulling the tie piece of the middle cone to the side of the flexible hose, draws upward the second tie piece of the lower cone until the lower cone coincides with the louver buckle of the lower flap. After doing this, the packer hands the tie piece of the lower cone to the assistant, who pulls it up and draws the cone into the louver, and the packer takes from the cone the pin and with it fastens the lower cone to the 2 louvers(put on it)(figure 73) of the lower and right flaps above the buckle of the lower end flap. After this they remove the tie pieces from the cones in the direction towards the lower flap.

After all the flaps are tightened, one proceeds to straighten and arrange the corner flaps.

The corner flaps are straightened out with a ruler, one end of which is placed in the small pocket of the flaps. We first straighten the upper flaps, after them, the lower (corner) and lateral. In arranging the corner flaps, which are near the loose ends of the suspension system, it is necessary beforehand to clear with the ruler a place for them. It is necessary to do this with caution in order not to damage the canopy of the parachute with the ruler(figure 74).

The lower pin of the rip cord is fastened with thread No. 30 or No. 40 and then sealed(stamped) after which one fastens the protective flaps. The rubber straps are not tightened until the parachute is put on (figure 75). The rest of the time they should be unfastened and tied in pairs.

After packing of the parachute we record on its certificate and service list the date of packing and the packers sign it. In the service list they also make notations as to the defects noticed and the steps taken to correct them. The certificate is placed in the small pocket of the parachute and the service list is placed in the box in which the parachute is kept.

We have described the packing of the main parachute with the canopy of circular form for jumps with manual opening. In the packing of the parachute of this same type for a jump with forced opening with a "break line" it is necessary to disconnect the pilot chute from the "break line"; to employ for forced opening of the pack, we use the standard static line with snap and loop, rip cord with a loop and the "break line")(This is discussed on pages 134-136, where we describe the sport-training parachute with a canopy of a square form).

Instead of the disconnected pilot chute, we attach to the apex bridle, with a special knot, a "break line", and the other 2 ends of it are connected by the same kind of knot to the loop of the static line.

In the tightened condition one of the ends of the "break line" should have some slack, equal to one-fourth the length of the other stretched end of the shroud line.

The rip cord is placed with the loop through a special additional flexible hose sewed to the parachute, a hose which is passed under the right loose ends of the suspension system. The cord with its loop is connected by a special knot to the static line at a distance equal to the length of the arm, counting from the loop of the line. No protective cover is used with the rip cord.

The static line is mounted on the right side flap of the pack of the parachute under the upper and lower rubber straps (the middle rubber should pass under the static line). The loop of the static line and the loop of the rip cord are placed under the right lateral flap of the pack from above.

For packing of the parachute with forced method of opening of the pack and with employment of a pilot parachute, it is necessary to fasten the pilot parachute to the apex bridle of the canopy with the aid of the "break" line. The static line, with the rip cord, is mounted also as described in the preceding method. We carry out the packing of the line on the right flap in the same manner.

The emergency ring(of the parachute with the square canopy) is put through the main flexible hose of the parachute, and the ring is placed in the pocket for the rip cord ring, placed on the circular strap of the suspension system(When we employ the emergency ring of the main hose, the opening device must be sewed at a distance of 85mm from the axis of the first cone).

The upper end of the rip cord with the ring before closing of the upper cone is

placedin the loop of the cord of the emergency ring, the protective cover on the static line is not employed.

THE EMERGENCY PARACHUTE WITH THE ROUND CANOPY

Description of the parachute. The reserve parachute has no harness (suspension system) and therefore may not be employed independently. It is employed together with any kind of training parachute, in case of a failure or break of the main canopy, for precise landing and for special assignments.

With a total weight of the parachutist of 100 kg, the velocity of landing on the reserve parachute is 7m/sec.

The reserve parachute consists of a canopy with shroud lines, an intermediate suspension system, a pack, a pull ring and a carrying bag. It may also be connected to the harness of life saving parachutes in the execution, with them, of training and sport jumps.

The canopy of the parachute is made of silk and has in ground plan the shape of a circle. The total area of a canopy is 42.5 sq. meters, it consists of 24 gores (panels) each gore consisting of 4 small panels. The pattern and joining of the gores and panels is the same as in the case of a canopy of the main parachute with the canopy of circular shape.

In the center of the canopy there is an apex vent having a diameter of 490 mm. The purpose of it is to soften the shock at the time of opening and to create a stable descent.

The shroud lines of the parachute, to the number of 24, consist of 12 silk cords. The length of the shroud line from the lower edge of the canopy up to the semi-ring of the intermediate suspension system is 4,5 meters. The shroud lines are connected to the canopy and to the semi-rings just as in the case of the main parachute with a canopy of a circular shape, but to each semi-ring there are fastened 6 shroud lines.

Along the radial seam of the canopy each shroud line is fastened in 4 places to the canopy by a zigzag stitch(lock stitch). For the stability of the shroud line there is an additional seam near the lower edge.

The counting of the gores is from the factory mark, counterclockwise. The counting of the shroud lines is done in the same way. The shroud line which is between the first and the second gore is regarded as the first. The tensile strength of a shroud line is 150 kg.

The intermediate suspension system serves for connecting the canopy and the shroud line of the reserve parachute to the main harness of the training parachute and consists of 2 pairs of straps with loose ends with semi-rings on one end. On the other 2 ends there are sewed fastening clamps. Each 2 pairs of loose ends of the intermediate suspension system is connected by a cross-piece which insures normal opening and descent, if the parachute is fastened to one clamp.

The intermediate suspension system is made of a semi-linen parachute web having a width of 44mm. The tensile strength of the strap is 1100 kg. The length of the loose ends of the straps from the semi-ring to the connecting clamp is from 710 to 750 mm(figure 76).

The pack of the parachute is made of aviation canvas of camouflage colored fabric (khaki). In the unfolded form it has the shape of an envelope. The length of the pack is 400 mm, the width is 300 mm, the height with the packed canopy is 120mm(figure 77).

The pack has 2 lateral flaps(on the long sides of the pack) and 2 end flaps(on the short sides).

On the right side flap there is sewed a pocket for the ring of the rip cord. Each end flap with its extension forms a protective flap, closing and protecting the opening device. For rigidity there is sewed in the protective flap a metallic plate. For the buttoning(fastening) the flaps have 2 buttons--"tourniquets".

On the left side flap there is the factory mark, the number of the parachute, the date of manufacture, and also the cones and louvers. On the upper end flap there is sewed a cone and on the lower a buckle-louver.

The upper and side flaps of the pack have corner flaps with pockets. For rigidity there is placed in the bottom of the pack a metallic frame, and in the flaps there are metallic plates.

On the inside of the pack, on the bottom of it, there are sewed with cotton 40 mm tape 2 rows of cells(loops) for the placing of the shrouds of the parachute. On the outside of the bottom of the pack there are sewed pockets for the certificate or service list, and also loops for the fastening of the pack elastic bands: on the long sides --2 each and on the short sides--1 each. The upper flap has an opening for the exit from the pack of the loose ends of the intermediate suspension system. For the opening of the flaps, the pack is provided with 6 pack elastics. To the bottom of the

pack, on the inside, there is sewed a PZ snap for the suspension of the ring of the rip cord after the opening of the canopy of the parachute, and also a handle for the carrying of the parachute(figure 78).

The pack is held on a level with the waist of the parachutist by means of 2 snap hooks, mounted in the suspension system of the main parachute; the snaps are fastened to 2 semi-rings(D-rings), sewed to the bottom of the pack of the reserve parachute, or fastened by means of a detachable fastening(figure 79).

The reserve parachute has for its opening a rip cord ring with a short line and with 2 pins. The ring is of a trapezoidal shape, made of 7 mm steel wire and zinc coated. The place for fastening the cord to the ring has a hook(cramp). Half of the ring, projecting from the pocket of the flap of the pack, is painted a red color, so that it can easily be found in the air, and is bent towards the outside. The length of the cord from the loop to the end of the pin is 130 mm(figure 80).

The carrying bag, with dimensions of 225 x 400 x 360 meters, is made of aviation canvas. It has a cover fastened with buttons--"tourniquets". On the cover and sides there are attached some loops through which we pass the thread for the sealing of the sack. On one of the sides there are sewed loops and a pocket for the bag.

PACKING OF THE RESERVE PARACHUTE WITH THE CANOPY OF CIRCULAR FORM.

The inspection of the reserve parachute is carried out in the same sequence as that for the main parachute with the canopy of circular shape. After making sure that everything is in good condition, we proceed to pack, first putting into the cones of the pack the cords for tying and placing the ring of the rip cord in the pocket.

The ring of the rip cord should be placed in the pocket so that the bend part of it will be directed outwardly from the pack.

The packing of the canopy of the reserve parachute starts with the 12th shroud line and after this does not differ in any way from the method of the packing of the canopy of the main parachute with the canopy of circular shape described above, and is carried out in the same sequence. After the packing of the canopy, we check the correctness of the packing and then proceed to pack the shroud lines and the canopy in the pack.

The pack is placed on the table so that its side flap with the ring of the rip cord will be on the right side of the table. The flaps should be turned under the pack.

After this one places on the pack the intermediate system so that its cross piece will lie between the cells and the upper edge of the pack, and so that the loose ends will be over the exits(openings) of the upper flap of the pack. (figure 81).

The packing of the shroud lines in the cells of the pack. The packer, who is on the left side of the table, moving back by about 19 inches from the D-ring, takes with his right hand all the bunch of shroud lines, bends them around the index finger of his right hand, and with his left hand places the hook in the left upper cell near the lower flap of the pack. With the hook he takes from the index finger of his right hand the loop of the bunch of shroud lines, thrusts it into the cell and with his right hand pulls and straightens the shroud lines. After this the shroud lines are placed in the opposite cell(figure 82). In this manner one fills all the cells of the pack. The assistant, who, during the time of the packing of the shroud lines, is on the right side of the table, holds the shroud lines placed in the cells, and also holds the pack so that it does not move over the table.

After the packing of all the shroud lines in the cells, what is left of them, equal to 1--1.5 meters, should be arranged zigzag above the shroud lines already in place(figure 83).

The packing of the canopy in the pack is done just as in the case of the canopy of the main parachute with the round canopy.

Tightening of the pack. The assistant, with his hands,presses down upon the canopy of the parachute and the packer places the left flap, with the cone, on the canopy. After this the assistant removes his hand from the canopy, takes the right lateral flap and puts it on top of the left flap (figure 84). The packer puts the tie piece, running from the cone of the left side flap, into the louver of the right flap corresponding to this cone and the assistant, taking hold of this tie piece, pulls it and puts the cone into the louver, after which he fixes it with an auxiliary pin (figure 85). The packer arranges the edge of the upper flap under the lateral flaps (figure 86).

After this the packer puts the tie piece from the upper end flap of the pack into the louver of the left side flap. The assistant takes it and puts the cone into the louver, and the packer makes it fast by means of a pin(figure 87). After this the assistant puts the same tie piece into the cone of the right side flap, and the packer pulls the cone to himself, holding the protective flap of the closing device until the

cone shows in the louver. The packer takes [illegible] the auxiliary pin, and the assistant puts the cone into the louver and places in the opening of the cone the pin of the ring of the rip cord(figure 88).

For tightening the lower flap one puts into the louver-buckle of the lower flap the 2tie pieces which are in the cones, and with them the packer pulls the louver-buckle to the cone. The assistant, during this time, arranges the flap with the ruler(figure 89). When the cone appears in the louver-buckle, the packer should pull one tie piece from the tightened cone upward, and the other one he should pull towards himself. After this the packer hands the tie piece from the main cone to the assistant, who pulls it upward, holding the cone in the louver. The packer, continuing to pull towards himself the other tie piece, takes out the auxiliary pin from the cone. The assistant puts the cone into the louver-buckle of the lower end flap and places in the opening of the cone the pin of the ring of the rip cord(figure 90), after which the pull cord from the cones are taken out. The assistant arranges with the ruler the corner flaps of the pack and arranges the main flaps(figure 91).

The pins of the rip cord are made fast with a thread and sealed with a stamp, after which the protective flap of the opening device is fastened (buttoned) and the parachute is placed in the carrying bag. The elastic straps should not be tightened until before the jump (figure 92).

When we store the parachute,we should tie the elastic straps in pairs on the bottom of the pack. The parachute may be transported only in the bag.

CONNECTION OF THE RESERVE PARACHUTE WITH THE SUSPENSION SYSTEM(HARNESS) OF THE MAIN PARACHUTE

Before connecting the reserve parachute to the suspension system of the main parachute, the suspension system of the main parachute should be adjusted to the height of the trainee, so that it will not interfere with his movements and at the same time will fit closely and uniformly around his body. For this purpose the trainee takes the suspension system of the main parachute in both hands, by the main strap at the place of the branching of the loose ends and, after making sure of the correct arrangement of the parts of it, places both hands one after the other--first the left and then the right--into the corresponding opening, formed by the main circular strap and by the shoulder straps.

After this he adjusts to his height the back-shoulder straps, which is done by a symmetrical movement of the straps through the bent(cambered) rectangular buckle of the main circular strap.

The chest crosspiece is adjusted by tightening or loosening the waist strap by means of small rectangular buckles, and the leg straps--by means of a buckle placed on them.

After this the snap hooks of the chest crosspiece and the leg straps are fastened so that the springs of the snap hooks will be turned towards the body of the parachutist.

The connection of the intermediate system of the reserve parachute to the suspension system of the main parachute is done in the following manner:

The catches of the lock of the pins are taken from the clamps and unscrewed from the threads of the clamps. Over the middle cross piece of the cambered rectangular buckle we make a loop of the main circular strap and the back-shoulder strap. On the loop we place the cramp(hook) of the intermediate suspension system of the reserve parachute; we put a pin into the opening of the strap loop obtained and screw it up as far as it will go. In the same manner we connect also the second cramp. If the cramp is correctly connected the catch of the lock of the pin should be on the outside and pressed tightly to the cramp(figure 93).

After the reserve parachute is connected to the main parachute, they are placed on the trainee. The trainee takes the reserve parachute with both hands, and the assistant takes with both hands the main parachute; they lift them and the trainee lowers his head between the ends of the intermediate suspension system of the reserve parachute. After this, while holding the reserve parachute, the trainee puts one arm after the other into the opening formed between the main circular strap and the shoulder straps, and then bending over, fastens the snap hook to the buckle(semi ring) of the reserve parachute. After this one fastens the leg straps and the chest cross piece(figure 94).

SPORT-TRAINING PARACHUTE WITH A CANOPY HAVING A SQUARE SHAPE

The parachute of this type is for making sport or training jumps from airplanes, gliders, and balloons. The parachute is used together with the reserve parachute.

The canopy of the parachute is put in the pack and arranged on the back of the parachutist (figure 95).

The parachute consists of the following basic parts: canopy with shroud lines,

suspension system, pack, cover for the canopy, pilot parachute with a spring mechanism, 2 flexible hoses, rip cord, static line, protective sleeve or cover of the rip cord, emergency ring of the rip cord(hand pull), rip cord ring, 1 meter and 2 meter connecting lines, "break line"(double), carrying bag and service list(figure 96).

THE CANOPY OF THE PARACHUTE WITH THE SHROUD LINES.

The canopy of the parachute is made of cotton fabric--percale. It has the shape of a square with cut off corners, sewed together with 8 or 10 panels or gores (depending upon the width of the panels) of the same width, with a lock stitch, with 2 parallel stitches.

The surface of the canopy is reinforced by a framework of mutually intersecting tapes having a width of 13 and 25mm. The edge of the canopy is reinforced with a 25 mm tape. For the fastening of the shroud line to the canopy there are placed along its edge(skirt) 22 loops, formed of a tape "framework". The other ends of the shroud lines are fastened to the semi-rings(D-rings) of the 4 loose ends of the suspension system (6 shroud lines to each semi-ring). The length of the shroud line is 6.5 m. The shrould lines are fastened to the loops of the canopy by a simple knot and their ends are stitched to the shroud-line by a zigzag stitch. The shroud lines are made of cotton cord. After jumps, the separate shroud lines become stretched out, the shroud lines around the cutout of the canopy being stretched out more than the others. In this case, if the shroud line exceeds their regular length by more than 400 mm, the parachute is considered to be unserviceable.

The 3 middle reinforcing tapes of the first panel and the middle reinforcing tapes of the remaining 3 sides of the canopy do not end in loops, as a result of which, when the canopy descends, it forms 4 cutouts.

The cutout of the first panel, at the place of the factory mark, is the largest. During the descent it is behind the parachutist. The stream of air flowing from the large cutout creates a reactive force. By skillfully turning the cutout, the parachutist can, in descent, control the parachute, reducing or increasing the drift in the direction of the wind or he can change the direction of descent and also exercise a control in the velocity of the landing. The large cutout is limited by 2 double shroud lines (1st and 22nd), which carry the greatest load in the filling of the canopy.

In order that the canopy may be filled with air more quickly, especially at the beginning of the filling, when the entrance opening is still small, there are sewed along the edge (the skirt of the canopy) 16 pockets (figure 97).

In the center of the canopy, on the outside, there are sewed 2 tapes, forming with them an intersecting loop, to which there is fastened the break line when we pack the parachute without a canopy cover. In the packing of the canopy this loop serves for the fastening of the canopy to the peg of the packing table.

The counting of the panels(gores) is done from the panel with the factory mark, and the squares are counted from the right to the left. The counting of the shroud lines is counter clock wise, and also from the factory mark. On the right side of the factory mark there will be the first double shroud line, and to the left there will be the 22nd double shroud line.

The area of the canopy is 70 sq. meters.

The suspension system(harness) of the main parachute with a square canopy is the same as the suspension system described above of the main parachute with the round canopy.

THE PACK OF THE PARACHUTE

In construction the pack of the parachute does not differ fundamentally from the construction of the pack of the main parachute with a canopy of circular shape. The minor constructional differences boil down to the following (figures 98 and 99).

On the right side flap of the pack there are sewed 2 pockets for the placing of the static line (in accordance with the last instructions the line is placed, not in the pocket, but under the elastic straps, tightened above the pockets), 1 pocket with a coat loop for the packing and the fixing of the snap hook and the ring for the fixing of the static line. On the upper part of the right lateral flap there is sewed a holding ring for the fastening of the hose in the packing of the parachute with manual opening, without the static line and rip cord, and if this hose is not used for mounting of the semi-automatic parachute device.

To the upper flap there are sewed 2 flexible pieces of hose which direct the movement of the rip cord, the emergency cords and the pull ring of the rip cord when they are pulled. The hose pieces also protect the cords against accidental catching. The other end of the flexible hose of the cord for the emergency ring and of the ring of the rip cord for manual opening is sewed to the suspension system over the pocket

for the ring of the cord. The length of the flexible pieces of hose is 515--520 mm.

The dimensions of the flaps of the pack of the main parachute with the canopy of square shape is somewhat greater than the dimensions of the flaps of the pack of the main parachute with a round canopy.

PARACHUTE COVER

The parachute cover increases the time of opening of the parachute. It also causes the load imposed by the parachute filling with air to be applied more gradually. The cover also assists in regulating the opening of the parachute(figure 100).

The parachute cover is made of percale in the shape of a sleeve, having a length of 4120 mm, and is a bright orange color, so that it can be easily found after a jump.

On the lower part of the canopy there are sewed to its surface eight pairs of fixed "cells" of cotton webbing and one pair of movable rubber loops in which to place the parachute rigging(shroud) lines. When the rigging lines have been packed in the "cells", the whole is covered by a protective flag, with tie pieces, which is sewed to the cover on the right side.

The inside of the "cell" are made from 25mm half-silk webbing in order to reduce friction when the rigging lines pull free.

The lower part of the cover is closed by an apron sewed to its face end and having two apertures for the insertion of the first pair of rubber loops(cells). These apertures on the apron of the cover are reinforced with a rectangular metal frame. In this way the rigging lines, inserted in the first pair of cells of the cover, lock the apron, and the canopy cannot be released from the cover until the rigging lines have pulled completely free of the cells.

The first two pairs of detachable cells are made of rubber cord, as an insurance against the rigging lines, in pulling free from the honeycombs, becoming wedged. As a result of being pulled by the rigging (shroud) lines, the rubber "cells"(loops) will be stretched or, in an extreme case, pulled out and the parachute will open normally. The broken loops are replaced by new ones on the spot.

A special packing frame is used for placing the rigging lines into the "cells" of the cover. Two cotton tapes, forming a pocket, are sewed on both sides of the cells for the placing of it. In the packing of the shroud lines into the cells(loops) we place in these pockets the packing frame, which is taken out after the packing.

The pulling of the canopy cover from the parachute pack, and of the rigging lines from the cells of the cover and, finally, of the cover from the canopy of the parachute is accomplished by the spring operated pilot chute. To assist this process, and in case of any failure in the pilot chute, there are sewed to the upper part of the cover two pockets which become filled with air. The pockets, when filled with air, assist the pilot chute.(1).

(1) In order that the cover, after it has been pulled free of the parachute may not be lost, it is equipped, in individual cases, with a connecting line made of double stitched silk cord, 4 meters long, one of whose ends is fastened to the loop at the top of the parachute and the vent bridle of the cover. There is a flap with cells in the upper part of the cover for the placing of this line.

For the strengthening of the cover over all its length, it is reinforced by stitching on four 25 mm cotton tapes, which at their intersection in the upper part of the cover, form the loop of the bridle of the cover at the apex vent.

PILOT PARACHUTE WITH A SPRING MECHANISM.

The construction of the pilot parachute of the main parachute with a canopy of square shape does not differ in any way from the construction of the pilot parachute of the main parachute with a canopy of circular shape.

ONE-METER CONNECTING LINE

The one-meter connecting line is for connecting the pilot chute to the bridle of the canopy cover. It consists of a cotton cord having a tensile strength of 125 kg, doubled and sewed together with a zig-zag stitch.

The main square parachute is provided with two methods of opening: static line (forced) operated or hand operated, which function independently of each other. The parachute can also be packed with the hand operated gear only, for example for delayed jumps.

THE STATIC LINE

The forced opening of the pack is done by means of the static line, one end of which has a snap hook by which it is attached to the aircraft (by a special clamp or a special cable), and the other end is fastened with a loop to the loop of the "release cable"(rip cord) of the opening gear(figure 101). The line consists of a flax rope 12-14 mm in diameter and 3.9 meters long. At a distance of 1.5 m from the

hook there is a loop inserted in the line for fastening to the parachute pack. Next to the hook a pocket is attached to the line for the "static line history booklet" (service list), in which is recorded the number of times the line has been used for jumps. Jumps from aircraft and from balloons are recorded separately in this booklet, on special sheets.

The static line is placed on the right side pocket of the parachute pack.

After the parachutist has left the aircraft, the static line extends to its full length, and pulls after it the "release cable" and pins of the release cable from the cones of the parachute pack, or, if the jump is made from a balloon, then the snatch line pulls the parachute and rigging lines from the pack and puts the parachute into operation.

EMERGENCY RELEASE RING

When the gear for static line opening is assembled, an emergency release ring is placed in the hose for the hand rip-cord, for use in case the static line, should break during a jump or in case of an emergency jump from an aircraft, when it is impossible to secure the hook to the aircraft's cable. It is a ring of trapezoid shape (the same as in the ring for the hand rip-cord) with a cable, ending in a loop, into which there is inserted the upper pin of the release cable of the static line opening system (figure 102).

RELEASE CABLE (rip cord)

The release cable is designed for the static line opening of the parachute. Its length from the end of the lowest pin to the loop is 1037 -1057 mm. Instead of the usual metal ring, the cable has a loop of braided (covered) cotton, by means of which it is connected to the static line. The other end of the cable terminates in the usual three pins for locking the eyelet holes (louvers) of the cones of the flaps of the parachute pack. (figure 103).

PROTECTIVE COVER

In order not to damage the skin of the aircraft, the release cable is provided with a protective cover of stitched waterproof material shaped like a sleeve, at the end of which there is a detachable sleeve with a tape. This is slipped over the static line, and after the parachute pack opens it slides down the static line until it covers the release cable. The length of the cover is 1340 mm (figure 104).

SNATCH LINE("break line")

For jumps from a balloon we use a parachute equipped with a snatch line(forced) for opening the parachute pack. In this case, the pilot chute and parachute cover are not used. The parachute and rigging lines are pulled out of the pack by means of a snatch line, consisting of a double cord of cotton. The lengths of the ends of this cord are 680 and 710mm respectively. One end of the snatch line is stitched, and forms a loop for tying to the loop of the canopy of the parachute. The other ends of the snatch line are attached to the loop of the static line in such a way that when they are extendéd one end has a slack equal to one fourth of the length of the other end.

RELEASE RING(ring of the rip cord)

The parachute may be opened by the parachutist himself, if it is arranged for manual opening. But manual opening of the pack is used only for jumps from aircraft. Jumps from balloons are made with the static line without the pilot chute.
For opening the parachute by the manual method, we use the pull ring of the rip cord, consisting of the body of the ring, rip cord with three pins and the stop of the cord. In construction, the ring is the same as in the main parachute with a round canopy. The length of the cable from the end of the last pin to the stop is 1022 mm. (figure 35).

SACK(BAG)

The parachute bag is made of airplane canvas, and has two carrying handles and a cover which is fastened by means of "turn-buttons". On the outside end of the bag there is a loop and a pocket for attaching and placing of the parachute tag. Around the rim of the cover and the lateral sides of the bag there are loops for the passing of the threads when the bag is sealed. The bag is for storing and carrying the parachute. The dimensions of it with the parachute stowed inside are 590 x 276x 390 mm.

INTERACTION OF THE PARTS OF THE MAIN PARACHUTE WITH THE CANOPY OF SQUARE FORM WHEN IT IS OPENED AND THE FUNCTIONING OF THE PARACHUTE IN THE AIR

At the moment the parachute starts to function, by means of the opening device, the pack elastics push the flaps of the pack to the side. The spring mechanism pushes from the pack and opens the pilot parachute. As a result of the resistance

of the air, the pilot parachute slows up the movement. At the same time, by means of a one meter connecting line, attached to the loop of the bridle of the cover of the canopy of the main parachute, the cover with the canopy of the main parachute is pulled from the open pack, and the shroud lines of the canopy are pulled from the cells of the cover of the canopy.

At the moment the shroud lines are pulled out to their full length, the apron is released and the cover is pulled from the canopy of the parachute. Two pockets arranged on the upper part of the cover assist the pilot parachute.

From the moment of the opening of the parachute up to the complete pulling out of the canopy and the shroud lines the parachute functions by itself alone; the pilot parachute has come out and opened up, the cover is pulled off, the shroud lines are stretched, and the cover has left the canopy of the main parachute. The parachutist during this time drops, subject only to the resistance of the air, and the effort necessary for pulling the shroud lines from the cells(loops) of the cover of the canopy. When it is pulled out the parachute is prepared for its basic work, namely, the breaking of the velocity of the fall of the parachutist.

A faultless preliminary preparation ensures the proper functioning of the parachute when the canopy fills with air. The spring mechanism of the pilot parachute makes a quick and reliable opening of the pilot parachute, isolates the cover of the canopy of the main parachute from its shroud lines in the process of the pulling out and prevents them from becoming entangled with the canopy.

During the opening of the parachute, the canopy of which does not have any cover, there have been cases of entanglement of the canopy with the shroud lines. This leads to a reduction of its working surface, an increase in the velocity of descent and damage to the fabric of the canopy ("burns" and rents).

The increase in the time of the pulling out of the parachute, because of the time necessary for pulling off the cover, makes it possible to reduce the load(shock) acting on the parachutist in the process of the filling of the canopy with air (the force of the jerk depends on the speed of fall). We bear in mind that during the time of the pulling out of the parachute after the separation of the parachutist from the airplane flying horizontally, the velocity of drop of the parachutist is decreased as a result of the resistance of the air. The longer the process of pulling out, the greater the reduction in the speed of fall of the parachutist at the moment of

the filling of the canopy.

The fact that the shroud lines of the canopy are placed on the cover also has great importance. During the time of the pulling of the shroud lines from the cells of the cover, beginning with the loose ends of the suspension system, the parachutist, as a rule, swings in the air with his feet downward. With this position of the body, of the parachutist, the load or stress created at the moment of the filling of the canopy acts in the direction head-feet, a position in which the body can most easily withstand the shock. If, however, there is no cover, as for example in the case of the main parachute with a canopy of a circular form, then the pulling out of the shroud lines from the cells of the pack starts from the canopy of the parachute and the filling of the canopy may start before the shroud lines are stretched their full length. In this case the moment of the filling of the canopy may force the parachutist to fall in a different position(head, side or back downward). As a result of this the shock(load) received upon the opening of the parachute at velocities of 220---250 km per hour is felt more.

In addition to this, the cover of the canopy insures normal functioning of the parachute even when the pilot parachute catches on the parachutist.

At the moment of the pulling out of the canopy and the shroud lines to their full length, the canopy begins to fill, the area of the resistance of the air is increased and there is a decrease in the speed of fall of the parachutist.

Depending upon the shape and the construction of the canopy, the number and length of the shroud lines, the character and penetrability of the fabric for air, the descent with a filled canopy will be steady---without special swinging or unsteady ---with swinging. The swinging complicates the process of landing, which cannot always be effected in a satisfactory manner. Hence, the shape and the construction of the canopy should be such as to insure landing without swinging. The square canopy parachute meets precisely these requirements.

THE PACKING OF THE PARACHUTE WITH THE CANOPY OF SQUARE SHAPE

For the making of training and sport jumps in the aero-clubs and training organizations of the Dosaaf one may employ the main parachutes with a canopy of square shape only in the following variants of the opening device:

---In jumps from transport planes by the method of forced opening(static line) of the pack with employment of the cover of the canopy with a pilot parachute; the

speed of the airplane at the moment the parachutist leaves it should not be less than 130 km per hour.

--In jumps from an airplane by the method of manual opening of the parachute with employment of the cover of the canopy with the pilot parachute; the speed of the airplane at the moment the parachutist leaves should not be less than 100 km per hour;

--In jumps from a balloon by the method of forced opening of the parachute by the static line, with snatch lines without the pilot parachute and the cover of the canopy;

--In parachute jumps from the airplane Po-2 by the method of forced opening of the pack with forced pulling away of the cover of the canopy by the static line; the speed of the airplane at the moment the parachutist leaves it should be at least 100 km per hour.

In addition to the usual tools for packing, in the packing of the shroud lines in the cells of the cover of the canopy of the parachute with a canopy of square shape we employ a packing frame. The frame should be well polished and its edges carefully rounded. If on the cover of the canopy we employ a four-meter connecting line and a flap with cells(loops) for it, then for the packing of the shroud lines in the cells of the flap we need a special fork.

A PACKING OF THE MAIN PARACHUTE WITH A CANOPY OF SQUARE SHAPE FOR JUMPS FROM AN AIRPLANE WITH FORCED OPENING OF THE PACK, WITH EMPLOYMENT OF A COVER FOR THE CANOPY WITH THE PILOT PARACHUTE

Before the beginning of the packing, the parachute should be carefully examined in the following sequence: the canopy with the shroud lines(figure 105 and 106), the suspension system, the pack with the pieces of hose, the rip cord, the emergency rip cord ring, the cover of the canopy of the parachute(cells, protective flap and the apron of the cover), the pilot parachute, the one meter connecting shroud line , the static line, the protective cover for the rip cord and the carrying bag. The packer should also get acquainted with the notations in the service list of the parachute and the static line.

After careful inspection and removal of the defects observed, the parachute is turned over for packing.

The packing of the main parachute with the canopy of square shape resembles in the main the packing of the main parachute with the canopy of circular shape and is done in the following sequence: inspection and preparation of the parachute for packing, packing of the canopy of the parachute, connection to the cover of the canopy of the pilot parachute, the placing of the cover on the canopy of the parachute, packing of the shroud lines in the cells of the cover, packing of the canopy with the cover and shroud lines into the pack of the parachute, tightening of the pack on the middle cone, packing of the pilot parachute and the final tightening of the pack, and, lastly, the connection of the static line to the rip cord, the placing of the protective cover on the line and the packing of it on the pack of the parachute.

Before starting to pack the parachute, it is necessary to place on the table all the packing instruments, put the strings for tightening, in the cones of the pack, put the cords in the flexible hose, and place the ring of the rip cord for emergency opening in the small pocket. The flaps of the pack should be folded under the pack and it should be placed on the suspension system so that the end flap with the ends of the flexible hose sewed to it will be turned towards the canopy. The suspension system should be arranged with the loose ends in pairs. The seam near the D-ring should be turned inward. The suspension system should be placed so that it will be put on the man standing with his face towards the canopy and the table.

The canopy of the parachute should be placed on the table with the factory mark panel upward(figure 107). In lifting the upper pair of loose ends of the suspension system, one should lift all the upper half of the canopy.

The packer, standing with his face towards the lower edge of the canopy on the left side of the table, takes with his left hand the left group of shroud lines, lifts it up and places the left half of the canopy on the right side of the table, holding with his right hand the lower edge of the canopy at the middle of the table, between shroud lines Nos. 11 and 12(figure 108). After this by dropping the lower edge he makes the loop of shroud line No. 12 coincide (places it on top) with the stitches of the perpendicular "framework" tape without loops, also making the lower edge coincide (figure 109).

The assistant holds in this position the lower edge of the canopy and the loop of shroud line No. 12, and the packer packs the panels from the lower edge to the apex of the canopy so that the perpendicular tape "framework" of the loop of shroud

Line No. 12 will lie along the middle of the table (figure 110).

Then the packer places on the loop of shroud line No. 12 the next loop of shroud line No. 13 and smoothes out lengthwise the next panel as pointed out above.

In this way one packs all the panels of the left half of the canopy up to the panel with the factory mark.

The longest panels, should be evened by turning under the excess length on the upper side of the folded panel.

The panels without shroud lines are folded in the same way as the panels with the shroud lines, and the perpendicular tape "framework" without the loop at the places of its stitch on the lower edge is placed on the folded loops of the shroud lines.

On the folded half of the panels of the canopy we place over its length 5 weights (figure 111). After this we fold the right half of the canopy. It is done in the same manner as the packing of the left half.

The packed canopy is folded over all of its length on both sides with an overlap along the width of the cover, after which we place on it the weights.

The excess length of the shroud lines resulting from the use of the parachute (not exceeding 400 mm) should be adjusted to the D-ring of the loose ends of the suspension system. Then we should check the correctness of the position of the shroud lines with respect to the canopy and the suspension system, for which purpose we lift the upper pairs of the loose ends of the suspension system. If the upper half of the canopy of the parachute corresponds to the upper loose ends of the suspension system, this means that the canopy of the parachute is packed correctly. In carrying out the check, it is necessary to hold the lower edge and the shroud lines at the edge of the packed canopy.

After checking the correctness of the packing of the canopy of the parachute we attach the pilot parachute to the cover, put the cover on the canopy, and put the shroud lines in the "cells"(loops) of the cover of the canopy.

After connecting the pilot parachute to the apex vent bridle of the cover of the canopy of the parachute, by means of a 1-meter connecting shroud line(figure 112) and after removing the weights from the canopy of the parachute, the assistant, through the apex vent of the cover puts on his right hand the cover of the canopy, and seizing with his index finger the apex vent loop of the canopy, he lifts it from

the peg.

The packer, taking hold of the edge of the apron of the cover(figure 113), draws the cover over the canopy of the parachute so that the shroud lines of the canopy, when they come from the cover, will be in the middle of it, between the "cells" of the cover.

Before the placing of the shroud lines in the cells of the cover, it is necessary first to place the packing frame in the special pockets that are on the cover(figure 114, A).

After this the packer takes all the shroud lines in his left hand and puts them on the cover between the cells, and with his right hand closes the apron of the cover of the canopy(figure 114 B), passing the loose(detachable) rubber loops("cells") of the cover through the opening of the apron. After this, through the pair of detachable rubber loops, by means of a hook, he draws the shroud lines and by this means closes the apron with the shroud lines. The further packing of the shroud lines in the cells of the cover, starting with the loop of the upper pair, is done in the same manner as in the case of the cells of the pack of the main parachute with a round canopy (figure 114, C).

After the completion of the packing of the shroud lines in the loops of the cover we pull out the packing frame from the pockets, cover the packed shroud lines with the protective flap of the cover and tie all the tapes and strings with knots as shown in figure 115.

The placing of the canopy in the cover into the pack(figures 116,117, 118,and 119), the tightening of the pack, and the packing in it of the pilot parachute are done just as in the case of the main parachute with the round canopy. But before we place the upper pin of the rip cord in the upper cone, we put on it the loop of the emergency cord.

After the tightening of the pack and the arrangement of the corners and side flaps, we connect the static line with the protective cover to the rip cord.

For connecting the loops of the static line to the loop of the rip cord it is necessary first to pass the loose end of the flexible hose under the right loose ends of the suspension system, pass the loop of the rip cord through the loop of the static line(120 A) and then put the snap hook of the static line through the loop of the rip cord (figure 120, B) and pull the line, taking with it the snap hook (figure 120, C).

In this manner we tighten the loops of the static line and the rip cord.

For placing the protective cover on the line, the snap hook of the line should be passed through the lower opening of the protective cover so that the lower end of the cover will overlap the loop obtained with the connection of the loop of the static line and the rip cord. After this the detachable sleeve should be tightly wrapped with tape by four turns and well tied by a reef knot, in a bow(figure 121). When the opening device functions, the detachable sleeve, having a diameter greater than the diameter of the line, slips along it and the case covers the rip cord with the pins. Further slipping of the case(cover) is prevented by the loops of the line and the rip cord.

After this we tighten the elastic pack straps on the right lateral flap and place the line on the pack under the upper and lower elastic straps on the right lateral flap(the middle elastic strap should also be fastened and should pass under the static line) and fasten to a ring with a linen thread having a tensile strength of 15 kg. In packing the static line under the elastic bands on the flap of the pack, the knot for connection of the static line and the rip cord should not extend out from the protective cover. The loose end of the flexible hose and the lower end of the protective cover should be arranged under the upper edge of the right lateral flap of the pack. The snap hook of the static line should be placed in its pocket, sewed to the right flap of the pack, and it should be fixed with a cotton thread No. 10 to the coat loop(figure 122) sewed on the pocket of the snap hook.

The rest of the elastic pack bands are tightened before the jump.

This method of opening the parachute is employed in jumps from airplanes AN-2 and others with a speed of flight at the moment of jumping from the plane of not less than 130 km per hour.

The packing of the main parachute with the square canopy for jumps from airplanes with manual opening of the pack, with employment of the cover of the canopy with the pilot parachute.

The inspection and preparation of the parachute for packing, the packing of the canopy, the placing of the cover on the canopy, the packing of the shroud lines in the "cells"(loops) of the cover, the packing of the canopy with the cover and shroud lines in the pack, the tightening of the pack and the packing of the pilot parachute in the pack are carried out in the same way as the packing of the parachute with

forced opening(static line opening) of the pack, with employment of the cover of the canopy with the pilot parachute(by the method described above). The difference consists only in the mounting of the opening device.

Instead of the rip cord and the emergency ring we employ a pull ring for manual opening, the pins of which also close the louvers on the cones of the pack(just as in the main parachute with the round canopy). The static line, the rip cord, the protective cover and the emergency ring with the cord loop are not mounted in the packing of the parachute for manual opening. The loose end of the flexible hose for the rip cord for forced opening of the pack is passed under the right loose ends of the suspension system and placed in the holding ring, sewed for this purpose above near the right lateral flap. We should fix the lower pin of the ring of the rip cord with threads, just as in the case of the main parachute with the round canopy.

The mounting of the semi-automatic parachute device on the main parachute with the square canopy is done in accordance with the instructions for the operation of the semi-automatic device. The given method for opening the parachute is employed in jumps from airplanes flying, at the moment of the jump, at not less than 100 km per hour.

PACKING THE MAIN SQUARE PARACHUTE FOR A BALLOON JUMP WITH STATIC LINE OPENING OF THE PACK AND SNATCH LINE(WITHOUT PILOT CHUTE AND PARACHUTE COVER)

In this variation, the protective cover for the release cable(rip cord) the pilot chute, and the parachute cover, are not mounted.

The inspection and packing of the parachute are carried out in the same way as described above but without putting the cover on the parachute(canopy).

Stowing of the rigging(shroud) lines in the loops of the pack is done just as in the case of the main parachute of circular shape(figure 123) as is also the folding of the parachute, without its cover, into the pack(figure 124).

Instead of attaching the pilot chute to the apex loop of the parachute, we attach the snatch line(figure 125). The drawing together of the pack is done in the normal way, by locking the eyeleted cones with the pins of the release cable, while the free ends of the snatch line are brought outside, between the right and upper flaps of the pack(figure 126).

The free end of the flexible hose is brought under the right loose ends of the suspension system and the loop of the release cable(rip cord) is joined to the static

line at a full arms' span distance from its loop(figure 127). The free end of the hose, with the loop of the rip cord, attached to the static line, is stowed behind the upper edge of the right hand flap.

Both ends of the snatch line are tied to the loop of the static line in such a way that one is shorter by one-fourth the length of the other. The loop of the static line, with the snatch line attached, is placed between the upper and right side flaps. The remainder of the static line is stowed beneath the rubber band of the side flap and fastened by means of a flax thread with a 15 kg tensile strength(figure 128).

In the training organizations and aeroclubs of Dosaaf the main square parachute is packed for static line opening of the pack, with employment of the canopy cover which is pulled off the parachute by the static line, when jumping from aircraft PO-2. With this variation of packing, the speed of aircraft PO-2 at the moment of jumping must be not less than 100 km/hr. At a lower speed the parachute may become entangled in the rigging lines.

Packing of the parachute for jumping from an aircraft in this manner is done in the same way as the packing, described above, of the square parachute for jumps from aircraft using static line opening, the parachute cover, and the pilot chute. But instead of the pilot chute, a 2-meter connecting line is used with a breaking strain of 500 kg. Special 25 mm webbing or a sewed 4-ply line, factory made, may also be used as a connecting line. One end of this connecting line is tied to the apex bridle of the parachute cover, and the other to the loop of the static line.

The place where the static line is tied to the pack, with the parachute stowed, must be 1600 mm from the static line hook. The static line is fastened with six-strand thread with a 15 kg breaking strain.

Before each jump it is essential to check the knots tying the connecting line to the static line and to the parachute cover.

After the jump, the accompanying pilot is obliged to drop the static line and parachute cover at a place appointed for this. It is forbidden to pull it into the cabin of aircraft PO-2, and landing the aircraft towing the static line and parachute cover is also forbidden.

THE EMERGENCY PARACHUTE WITH A SQUARE CANOPY

The reserve parachute consists of a canopy with shroud lines, intermediate suspension system, a pack, the ring of the rip cord, carrying bag and parachute servic

list.

The parachute of this type is used only for jumps with parachutes having a canopy of a circular shape. The weight of the parachute is about 7 kg.

The canopy of the parachute has a square shape with cut off corners; its area is 42.5 sq. meters. The speed of descent is 7m/sec, with a parachutist weighing 100 kg(figure 129).

The canopy is sewed together with 7 silk panels, by a lock stitch and sewed with 2 parallel stitches. For increasing the strength of the canopy there is a system of reinforcing tapes 13 mm wide, semi-silk, on the outside, over all the area. The lower edge of the canopy is reinforced with a strip of tape having a width of 25 mm. Along the lower edge there are 22 loops for fastening of the shroud lines.

The 2 middle tapes of the first panel of the canopy, perpendicular reinforcements for the edge, do not have any loops, as a result of which, in descent, there is formed a cutout, facilitating the turning of the parachutist down, the wind the cutout being arranged behind the parachutist. In the center of the canopy, on the outside, there are sewed 2 tapes, forming with the intersection the so-called vent loop for fastening the canopy to the hook when one examines it or packs it.

The shroud lines, to the number of 22, are made of silk cord No.10, having a tensile strength of 150 kg each, the 1st and the 22nd of which are double. The shroud lines are fastened to the loops of the canopy by a simple knot, their ends being fastened with a zigzag stitch. The other ends are fastened to the D-rings of the loose ends of the intermediate suspension system. All the shroud lines are of the same length, this being equal to 4 meters in the loose condition of the shroud lines from the lower edge of the canopy to the D-ring.

During the time of the operation of the parachute, the separate shroud lines are elongated. The elongation of the shroud line should not exceed 100 mm.

The counting of the shroud lines runs from the factory mark counterclockwise.

The method of inspection and the packing of the square canopy of the reserve parachute is similar to the method of inspection and packing of the canopy of square shape of the main parachute described above.

The packing of the shroud lines into the loops("cells") of the pack, the canopy of the parachute into the pack, and the tightening of the pack are done in the same way as in the packing of the reserve parachute with a canopy of circular shape.

PARACHUTE PL-45

The PL-45 parachute serves as an individual life-saving means for the flying personnel in case of damage to the airplane. On the basis of the principle of operation it is a free type action parachute (manual opening). Before the flight, the parachute is put on the aviator and serves him as a seat, in the place of a cushion. The total weight of the parachute without the carrying bag does not exceed 10 kg.

The parachute consists of a canopy with shroud lines, the pilot parachute of the suspension system, a pack with a special pocket sewed to it for the fastening of the oxygen apparatus, the ring of the rip cord, the cushion and the carrying bag for storing and carrying of the parachute.

The canopy of the parachute PL-45 of square shape with cutoff corners is made by sewing together 7 panels of the same width. The area of the canopy is 42.5 sq. meters. The canopy is reinforced on the outside with tapes. The lower edge of the canopy consists of a double fold of fabric on the outside, with a strip tape on the inside, sewed with 4 stitches.

The tapes of the reinforcing "frame" around the perimeter of the canopy form 22 loops to which are attached the shroud lines of the parachute.

The two ends of the 2 middle tapes do not form a loop for the shroud lines, making it possible for the canopy during the descent to form a cutout, which facilitates the turning of the parachutist down the wind. The factory mark is placed on the cutout.

The silk shroud line, to the number of 22 (the 1st and 22nd of which are double) are tied to the loops of the canopy by a simple knot and their ends are lashed with a zigzag stitch to the corresponding shroud line.

The loose ends of the shroud lines, to the number of 24, are fastened to the 4 D-rings of the loose ends of the suspension system.

On the outside, in the center of the canopy, there are sewed 2 mutually perpendicular tapes, forming with their intersection a loop, to which is fastened the shroud line of the pilot parachute.

The pilot parachute is made of silk fabric and consists of 1 panel. Its area is 0.8 sq. meters. The outside surface of the canopy is reinforced with tapes. The

interlaced in an eye of the shroud line. The length of all the shroud lines if the same. The parachute does not have any spring mechanism and functions by the stretching of the elastic bands of the back. The elastic bands, when the pack opens, force out its flaps, which in their turn throw out the apron of the pilot parachute. The apron opens and the pilot parachute comes out.

The construction of the suspension system of parachute PL-45 is such that it makes possible rapid release from the parachute at the moment of landing(on land or water). When it is put on it is fastened at one point by means of a lock (instead of 3 points, as in the case of other parachutes which have snap hooks or buckles). (130 fig.).

For insuring a fixed position of the adjustable part of the leg, back-shoulder and waist straps, the suspension system has a soft back with a mobile cross piece and a waist holding ring and 4 buckles of a T-shape, appropriately mounted on the main waist strap, which, going into the opening of the body of the lock(catch), close the suspension system.

In order that the loose ends of the suspension system may not slip from the shoulder, there are arranged to the soft back some fastening flaps which are closed by means of special buttons.

The PT parachute lock(catch) makes it possible to fasten the suspension system at one point and to release it quickly from the parachute. The lock has a rectangular shape and consists of a cover with 2 locking pins with levers, a body with lateral openings for connecting the pin of the lock and the locking pins and with openings in the base for the mobile teeth. The lock has connecting screws, a locking plate, directed moment of the mobile teeth in the closing of the buckle with the lock, mounted on the inside body of the lock by means of 2 set screws with holding discs and a middle holder for the setting of the buckle(figure 131).

The basic parts of the lock are also movable teeth with springs, set between the body and the guard plate of the lock, the spiral spring of the lock, mounted on the pin of the lock for opening the cover, the spiral spring of the levers, set between the support pins of the evers under the cover of the lock, the guard against the opening of the levers of the lock, mounted on the cover and consisting of the body of the guard, the catches, pins and springs and the buckle of the locks, 3 of which are removable and 1 of which is fixed, are connected by means of a pin

and a cotter with the guard plate of the lock.

The TP lock closes 4 points of the suspension system by means of 2 buckles mounted on the chest crosspiece (one of these is fixed to the lock and the other is detachable), and 2 detachable buckles which are on the adjustable leg straps.

In connecting the buckle with the lock, the movable tooth countersinks and, going into the circular opening of the buckle, locks the buckle by the action of a spring.

In order that the aviator may not, by chance, press on the lever with the locking pins of the lock, the catch of the safety is set in the working position, that is, between the levers. In this case, when it is necessary to open the lock, the catches of the safety are thrown out on the cover and the levers are pressed by 2 fingers until the moment of the slipping of the buckle from the movable teeth.

While using the parachute it is forbidden to take the TP lock apart to make repairs or replace separate parts.

The pack serves for the packing of the canopy, shroud lines and pilot parachute. It is made of aviation canvas of a camouflage color.

The pack, of a box shape, has a bottom and 4 flaps: the main flap with the apron of the pilot parachute, 2 lateral flaps and a front or end flap. At the bottom of the pack there is a metallic frame to give rigidity.

On the main flap of the pack, on the inside, there is sewed a cotton apron, in which there is wrapped the pilot parachute. Upon the opening of the pack, its main flap, under the action of the stretched elastic pack bands, throws out the apron, which unfolds and releases the pilot parachute.

On the inside bottom of the pack there are 2 rows of cells, 6 in each row, for the placing of the shroud lines .

The main flap, the 2 lateral, and face flaps serve for the packing of the canopy and the shroud lines of the parachute by means of a locking device. It consists of 2 cones, placed on the end flap, and 4 louvers: 2 large and 2 small. The 2 small louvers are placed on the main flap, and the 2 large ones--on the lateral flaps.

The closing of the cones with the louvers placed on them is done by means of the 2 pins of the rip cord.

The main flap has a guard flap fastened by 3 buttons—the "tourniquet".

The flaps of the pack have some small corner flaps with pockets, 2 double and 2 single elastic bands, which, by means of hooks and loops, are fastened to the pack.

To the outside of the pack there are sewed some tapes by means of which one can fasten to the pack a cushion on which the aviator sits during the time of flight.

The ring of the rip cord serves for the opening of the parachute and consists of the body of the ring and the cord with 2 pins. The construction of the ring of the pilot parachute is the same as that of the training parachutes.

The inspection and the packing of the canopy of the parachute PL-45, before the packing of the shroud lines in the pack, is done in the same way as the inspection and packing of the canopy of the main parachute with the canopy of square shape. After this the method of packing is changed.

The pack of the parachute is placed on the suspension system with the cushion below; the flexible hose is placed on the left side. In the openings of the cones we place the strings, and in the flexible hose, the cord of the rip cord ring.

The loose ends of the suspension system are folded and placed on the pack, in the opening in the flap so that the D-rings will be at the middle of the pack. We begin the packing of the shroud lines with the right loop. The shroud lines are put in until they fill all of the loops. The requirements for the packing of the shroud lines in the loops are the same as for other types of parachutes. The rest of the shroud lines, after they are packed in the loops, should be equal to the length of the pack.

The canopy of the parachute should be placed on the shroud lines in the usual manner.

We start the tightening of the pack with the tie pieces of the lateral flaps and the cones fastened on the end flap. It is necessary to fill with the fabric of the canopy all 4 corners of the pack at the end and main flaps. By means of the tie pieces, the cones are pulled into the louvers of the lateral flaps and fastened, provisionally with the auxiliary pins.

The pilot parachute is laid out on the table in the form of a rectangular and the main and the central shroud lines are stretched at the lower edge, and the lateral sides of the folded parachute are turned outwardly. After this the parachute is rolled in the form of a cylinder.

The packed canopy of the pilot parachute is wrapped in the apron of the main flap on the outside by one turn. The shroud lines of the parachute are laid zigzag on the apron, and the wrapping of the parachute is completed. The pack is turned by 90°, the main flap is closed, and the assistant, during this time, pulls towards himself the end flap, and the packer pulls the main flap on the cone of the end flap.

After this the auxiliary pin is removed from the cone that is near the flexible hose. In the cone, tightened with the tie piece, we place the upper pin of the rip cord, and in the other cone we place the second pin of the rip cord. We fasten the lower pin of the rip cord with cotton thread No. 30 or No. 40 and seal it.

Before the flight of the elastic bands of the pack, one of the ends of which are tightly fastened(double on the main flap, and single on the bottom of the pack), have their other ends fastened by means of a hook to the coat loops attached, for the double elastic bands, at the bottom of the pack, under its cushion, for the single ones, to the lateral flaps.

The adjustment of the suspension system for the height of the person is done in sitting position.

CHAPTER IV

PRACTICING THE JUMP ELEMENTS ON THE GROUND, PHYSICAL TRAINING OF THE SPORTSMAN PARACHUTIST AND THE FLIGHT

General Instructions

Before starting jumps from an airplane or balloon, the parachutist should take some ground training in the parachute camp. Here he receives the necessary training, practices all of the steps of the jump, acquires skill in quickly orienting himself in the air under any circumstances and hardens himself physically. With good ground training, the parachute jump, in so far as its technical execution is concerned, does not present any great difficulties.

Exercises on the ground in the practicing of the jump steps are carried out on parachute training contrivances. Until the parachutist has mastered thoroughly all the steps and actions, he may not be allowed to make practice jumps.

Before the first jump each trainee naturally has some feeling of uncertainty. But, these same parachutists, if they have gone through the ground training properly, will, in the execution of the jump, follow all the rules and successfully accomplish the jump. They will make their jumps with relative assurance and calm.

In the training, special attention should be paid to learning the methods of leaving the airplane, the pulling of the rip cord ring, turns and landing. The future parachutist, during the time of the ground preparation, should become accustomed to controlling his body in the air.

The most difficult thing is to instil in the trainee skill in the intelligent and rapid employment of the prpper movement, that is, skill in quickly orienting himself. The inexperienced parachutist may be in an unfavorable position only because he has lost so much time in the execution of one movement that he does not have the time to carry out the others.

Hence, the parachutist may be allowed to jump only after he has thoroughly mastered the technique of all the movements--the steps of the jump--and has learned them to perfection, that is, to such an extent that he will lose no time in thinking out the proper movements and actions.

Such a stage of preparation is achieved by persistent and long training movements on the ground at the parachute camp. The basic purpose of ground training is, with each exercise, to increase the confidence of the trainee in his strength, knowledge and ability to carry out all the jump steps precisely and automatically. The exercises for learning the technique of the execution of the separate steps and then of all the steps as a whole should be carried out in strict sequence.

The ground practice of the steps of the jump consists in training on special parachute training apparatus and physical exercises.

The basic devices for the training of the parachutists are the following: the parachute tower, the aerial cable track, the ground parachute trainer NPT-2, the dummy cabins of aircraft, graded platforms, parachute harness suspended on pulleys, gymnastic wheel, "loping", and a movable net(spring net).

On this apparatus the future parachutists practice on the ground the following basic steps of the jump: boarding the airplane, taking position and conduct of the jumpers in the airplane, taking the initial position for the jump, leaving the aircraft, inspection of the canopy and arrangement of the leg straps, slipping, orientation in the air in parachuting, determination of the drift and the methods of turns, preparation for landing, and the landing itself, the sequence for getting clear of the suspension system in case of jumps on water, methods of jumps with

armament and equipment, rules for carrying out jumps at night, rules for landing on obstacles, methods and rules for opening the reserve parachute.

For the proper learning of all the steps of the jump, it is necessary to employ fully all the existing opportunities and to seek new methods and means of training.

DUMMY CABINS OF AIRPLANES

Dummy cabins of airplanes serve for learning on the ground the methods of taking one's place in the airplane, conduct during flight, the execution of the commands and signals, getting out of the cabin, taking the initial position and leaving the plane.

The dummies may be set up in a courtyard or indoors. The dimensions and shapes of them should correspond precisely to the dimensions and shapes of the airplane of the type from which jumps will be made. Usually one employs for this purpose airplanes which have been discarded.

The dummy should have a front and rear cabin, if it is a 2 seater(type PO-2), a part of the left lower "plane"(wing) (with a length of not less than 1 meter), and also a wing center panel with its 4 struts. The surface of the wing center panel should be covered with tar paper and the "plane" with corrugated rubber.

Usually, in the parachute camp, we construct cabins of airplanes of the types PO-2, UT-2, AK-2, YAK-12 and YAK-18.

PRACTICING THE JUMP ELEMENTS (STEPS) ON A DUMMY AIRPLANE

Jumps may be executing from all types of airplanes, and from all points and in any position of the airplane(diving, loops, spirals, horizontal turns, corkscrew spins). But in the first orienting jumps one selects the most convenient point and the simplest method of leaving the plane and opening the parachute. It is necessary that the method selected and the place of leaving makes it possible for the instructor to observe continuously the preparation of the parachutist and to make a timely correction of his errors.

In boarding an airplane the parachutist must observe the maximum caution in order not to damage the parts of the airplane and not to open the parachute prematurely. His uniform and equipment should be carefully fitted. If one discovers, any kind of insignificant defect, the parachutist should not be allowed to engage in the training. Before getting into the dummy airplane, the trainee must again recall the commands and signals for the preparation in flight and for leaving the airplane.

After the trainee has learned thoroughly the method and the technique of

boarding the plane, he passes to the practical exercises and the methods necessary in jumping from an airplane.

The instructor on the dummy plane demonstrates the methods of leaving the aircraft, taking of the initial position and the leaving, accompanying the demonstration with necessary explanations. The instructor should, in particular, remind the trainee of the most frequent errors committed by inexperienced parachutists and explain to each one what their results are.

After the demonstration and explanation, one starts the practical training of the parachutists in the technique of leaving the aircraft, the taking of the initial position and the jump. The instructor who is in the cabin gives the commands or signals and secures precise execution of all the rules of the jump.

One should practice very carefully the methods of leaving and the pulling of the ring. It is necessary that the trainee form the definite habit of not pulling the ring until after complete separation from the dummy.

As a result of the exercise the parachutist should be able to board the airplane correctly, to prepare for the jump, to occupy correctly the initial position for the jump, to leave the dummy correctly and to pull the ring of the main parachute at the proper time(if the jump is made with a free parachute, or manual opening).

TRAINING ON SWINGS IN CONTROLLING THE PARACHUTE AND METHODS OF LANDING

The technique of training for landing and the technique of the landing itself have great importance. As experience has shown, cases of injuries in parachute jumps occur most often at the time of landing. Hence, a trainee must not be allowed to practice a jump until after he has practiced on the ground all the necessary methods. This practice is done on parachute swings.

The parachute swings are employed for gaining skill in the execution of the following phases of the jump: inspection of the canopy, arrangement of the circular straps and the leg straps, the opening of the reserve parachute, turn of the body on the suspension system forcorrect landing, strictly down wind, the giving to the body (to the feet and to the body) the correct position for landing, landing and getting clear of the suspension system.

The swings may be set up either in the open air or indoors(the height of the rooms should be not less than 3-4 meters). They consist of a main framework cables which

are sufficiently strong, a suspension system, a system of pulleys and hand winches for raising and lowering. The winches should be operated by one man with an effort of not more than 10-15 kg(figure 132).

Over the area for the landing one should spread a layer of sawdust having a thickness of at least 0.5 meters. If the swings are constructed indoors, one should place mats at the place of the landing.

The instructor, before starting the training on the swings, has the trainees to form ranks and then reminds them of the rules of the jump and the actions which they should execute after the opening of the parachute, namely to inspect the canopy, make sure that it has opened properly, fasten the rings to the snap hook, arrange the circular strap of the suspension system, determine the direction of the wind and make use of the reserve parachute, if this is called for. After this the instructor puts on the suspension system and demonstrates in a practical manner everything that he has mentioned. After this he explains the rules for the execution of turns with crossing of the straps, emphasizing the importance of maintaining a correct position of the legs in landing.

After explaining and demonstrating all the methods, the instructor passes directly to the practical training of the parachutists. The parachutists whose turn it is puts on the suspension system, fastens the leg straps and the chest crosspiece, and, suspending himself a half meter from the ground, executes all the movements which he is to make in the air, after the opening of the parachute; he looks up to inspect the parachute, he secures the ring and arranges the leg straps.

Upon the command of the instructor, the trainee goes through all the turns demonstrated, and at first all the methods separately. After making sure that the trainee has mastered the method for correct grasping of the strap with his hands for the turn to both sides, the instructor passes to the giving of rapid orders: "You are approaching the ground", "Under You", "To the right", To the left".

The trainee should realize quickly when it is necessary to make a turn, find the proper straps quickly, pull them correctly and carry out the turns very accurately. The legs of the trainee should be loose and both feet should be on the same level.

After the trainee has learned correctly the rules of the turn and how to find quickly with his hands the proper strap, he passes to the study of the methods of landing. The instructor lifts the trainee on the parachute swings to a height of 2-3

meters above the ground and at first slowly and then quickly drops him to the ground, requiring him to hold his legs in the correct position for landing. Then this same movement is carried out with the turn.

After teaching the method of landing without swinging, the instructor passes to training in landing by a turn with swinging of the trainee and allowing him to land slowly.

In training on swings special attention should be paid to the position of the legs. In the case of parachutists with weak coordination of movement simultaneously with a change in the position of the arms and body, there is also a change in the position of the legs--they separate at the knees and feet. In training, it is necessary to see that the movement of the arms and body do not affect at all the position of the legs.

These steps are not learned until the trainee can execute automatically, after the opening of the parachute, all the turns on the suspension system and land with precise bringing together of the feet and knees.

The technique of landing should occupy a special place in all of the parachute training, even though the majority of jumpers at first regard it as a secondary matter. The fact is that after the opening of the parachute the jumper first feels that it is very far to the ground and he does not begin to prepare to land and to execute the turns until the ground is close to him. We have noticed how at this "responsible" moment the inexperienced parachutists loses his presence of mind, swings his legs and holds to the straps. Oftentimes the parachutist lands without executing the turn until the last moment and without preparing his feet for the landing.

Cases of injuries to the legs in landing are due to only one thing--incorrect landing, and this is due to the following circumstances:

After the opening of the parachute, the parachutist, hanging to the straps, should assume a comfortable semi-sitting position. But, the parachutist does not do this because of an incorrect adjustment of the suspension system. Then he makes the landing with outstretched legs and the jolt of the whole mass of his body is absorbed solely by the elasticity of the arches of his feet, without sufficient absorption by the rest of his joints(The instructor, in the period of training, demonstrates this error on the suspension system).

The parachutist lands, though sitting on the strap of the suspension system, but with his legs spread out to the sides. In this case, when he strikes the ground, the load is distributed unevenly over both feet and the shock is received only by one (the instructor demonstrates this error on the suspension system).

The parachutist does not sit properly on the strap; he either sits too far down or in a shallow position. In the first position the feet are turned under an angle forward and the shock is received chiefly by the heels, and not over all the foot uniformly. With insufficiently deep seating(shallow position) the parachutist places his feet forward on the windward side under a sharp angle. His feet are also in this position. During the time of the landing he receives the shock chiefly on his toes, which receive the pressure not only of the mass of the entire body but also of the additional forces of inertia of the movement forward.

The parachutists lands, without turning completely, on the side,. In this case his feet are a part and the shock is received more on the foot on the leeward side. In addition to this, the effort to fall forward causes the leg to turn with the danger of breaking it.

The parachutist lands against the wind, i.e., with his back in the direction of the wind. Such landing leads to an incorrect placing of the legs and may injure not only the legs but also the backbone and nape of the neck.

In the ground preparation the parachutist must find out why this or the other variant of landing mentioned above is incorrect or dangerous. He should learn to take the proper position on the suspension system, to make the turns with confidence, to pull the straps and to place his feet correctly, and to receive the shock properly at the time of the landing.

Injuries to the legs in the case of experienced parachutists are as a rule the result of over-confidence and a neglectful attitude towards landing. Some think that the wider the legs are apart, the more stable and softer the landing, because it forms a greater area of resistance. However, they forget that this is true only for a "stable" position. At the time of the jump, however, the problem is to create with two supports a single one and to absorb it by means of the muscles.

A correct landing position, excluding all possibilities of injuries, is one in which the parachutist, in approaching the point of landing, turns his face down

wind, semi-seated on the circular strap of the suspension system, holding his legs so that with an unchanged profile of the body only the toes will be visible behind the reserve parachute. The legs should be in a semi-tensed position with the feet and the knees together (the feet parellel with respect to the ground).

By meeting all of these requirements, the jerk on the ground is received uniformly by both feet, pardally absorbed by the elasticity of the arches of the feet (chiefly by the ligaments and muscles) with subsequent distribution of the load on the ankles, knees and pelvic joints with their ligaments and muscular apparatus.

GRADUATED PLATFORMS

The training in the technique of landing and for strengthening the ankle joints is carried out with the help of graded platforms(figure 133).

The graded platforms have 3 levels which are at a height of 1 meter; 1.5, and 2 meters. The jump from the upper level gives approximately the same feeling as the jolt from the landing by parachute.

The jumps from the graded platforms should start with the lowest level, gradually passing to the highest.

While training in jumps from the graded platform one should pay special attention to the correct position of the body and the legs upon leaving the platform and upon landing.

The training on the platform should be carried out systematically, because the strengthening of the ankle joints can be achieved only after long training.

The ground around the graded platforms, at the place of the landing of the trainees, should be loosened.

GROUND PARACHUTE TRAINER NPT-2(construction of Proniched)

The construction of the NPT-2 trainer is designed for the ground training of parachutists in the rules and methods of executing parachute jumps(figure 134).

On the trainer one can practice in consecutive order the following basic elements of the paradhute jump: the taking of the initial position for the jump from the airplane or other aircraft, the leaving of the aircraft, opening of the parachute by pulling the ring of the rip cord(in the training for jumps with a parachute of manual opening), the arrangement of the circular strap of the suspension system of the parachute, the opening of the reserve parachute, the preparation for landing(turns, correct position of the legs for landing), landing, preparation for jumps over water.

In addition to this, we create with the trainer conditions for the free fall of the parachutist from the moment of the separation from the airplane until the moment of the opening of the parachute and we can give some idea concerning the opening shock, the shock the parachutist receives when his parachute opens.

The trainer consists of the following main parts: a wooden rectangular frame the standing platform with a dummy cabin of an airplane or balloon, the cable system with counterweights and the ladder.

For making the jump from the trainer the trainee puts on the suspension system of the parachute, climbs up the ladder to the standing platform and fastens the loose ends of the suspension system to the snap hooks of the suspension cables of the trainer system. After this, upon the command of the director, the trainee leaves the standing platform in accordance with the rules for leaving the airplane or balloon, falls freely for about 3 meters and remains suspended from the cable system. In this case, the main counterweight should be fastened stationary, i.e., the ring of the cable should be fastened to the hook of the release arrangement.

In this period the trainee practices the technique of leaving the airplane, learns the free fall up until the opening of the canopy of the parachute and gets acquainted with the opening shock at the time of the filling of the canopy of the parachute.

After the free fall ("opening of the parachute") and the cessation of the swinging, the trainee, in accordance with the orders of the director, carries out the necessary movements in preparation for the landing(arrangement of the circular strap of the suspension system of the parachute, turns down the wind, opening of the reserve parachute etc.)

The descent of the trainee to the ground takes place upon the command of the director. The assistant director, standing around the release arrangement, turns the handle and releasesthe main counterweight, which under the action of the force of gravity of the trainee, moves upward. The trainee is dropped to the ground at a speed of 4.5 --5/m/sec, under an angle of 45-50 degrees to the horizontal, giving him an opportunity to practice the technique of landing.

RULES FOR THE OPERATION OF THE TRAINER

Training is permitted only on a trainer which is in good condition, under the

supervision of a director who is responsible for the preparation of the trainer for the exercises.

After the director has inspected the trainer, he assigns one assistant for releasing the device and another for the standing platform for the release of the trainees.

Before the beginning of the exercise, the main counterweight should be fastened, i.e., the ring of the cable should be placed on the hook of the release device.

Before starting the exercises, the director of the group explains to the trainees the rules for the execution of the jump from the trainer and recalls the commands which are given during exercises on the trainer.

The first command--"Get ready". After this command, the trainee takes the initial position for making the jump in accordance with the rules for the execution of a parachute jump from an airplane or balloon.

The second command--"Go"! Upon this command the trainee leaves the standing platform in accordance with the rules for leaving the aircraft.

The third command--"Prepare for landing". Upon this command the trainee makes the necessary preparations for the landing in accordance with the rules of preparation for landing with a parachute.

The fourth command--"Release". When this command is given, the assistant of the director of the exercise, standing near the release mechanism, turns the handle and releases the main counterweight. The trainee is lowered and makes the landing in accordance with the rules of a landing by parachute under real conditions.

The first and second commands are given by the jumpmaster who is on the standing platform, and the third and fourth commands are given by the director of the exercises.

The jumpmaster checks on the platform, to see if the suspension system of the parachute is properly arranged; before the beginning of the exercise he again reminds the trainee of the rules for leaving the aircraft, fastens the loose ends of the suspension system of the parachute of the next trainee to the suspension cable of the system of the trainer and releases the trainee, giving him the successive commands "get ready" and "go".

After the trainee is suspended on the cable system(the parachute opened), he carries out all the actions necessary in a real jump with a parachute(he inspects the canopy, arranges the circular strap, etc.). In addition to this, depending upon

the task at this moment, he can train in preparation for landing with weapons, for landing on water or in learning the rules for the opening of the reserve parachute. In the latter case there should be fastened to the dummy of the parachute of the trainee a reserve parachute, training in the opening of which should be carried out in wind up to 6 meters per sec.

The director of the exercises, after making sure that the actions of the trainee are correct, gives the command "Prepare yourself for landing". Upon this command the trainee prepares for landing, after which the director gives the command "Release".

With each NPT-2 trainer there should be a "service list".

PARACHUTE TOWER

One of the best pieces of apparatus for the learning of skills on the ground and one necessary for the parachutist is the parachute tower(figure 135).

The towers are metallic or wooden structures having a height of 25 to 90 meters. The height of the wooden towers generally does not exceed 35 meters.

Parachute towers on the basis of their purpose and construction are classes as aeroclub and display ("attraction") towers.

The aeroclub towers differ from the display towers by the fact that on their upper platform there are placed dummy cabins of airplanes for training in climbing out of the airplane and leaving it, and the suspension systems have dummy packs of the main and reserve parachute.

The parachute towers are constructed on the basis of standard designs. After the completion of the construction, the tower is accepted by a special commission and it may not be used for jumping until after this acceptance.

The parachute platform is served by the instructor or experienced parachute sportsman assigned for this purpose.

Before each exercise the tower is inspected and the result of the inspection is recorded in its service list. The tower is used in keeping with the methods and programs for the training of parachutists.

The ground around the tower in the radius of the possible landing of the parachutist should be dry and loose or covered with sawdust. The thickness of the soft layer should be not less than 0.3 meters. On the tower it is mandatory to have a lightning rod. The speed of landing in jumps from the tower should not exceed

3--4m/sec. The tower should allow a free fall of 2--3 meters.

The wooden tower is equipped with fire fighting devices(fire extinguishers, a keg of water and buckets, boxes with sand and a shovel, an axe, a pick etc) and is kept under guard.

The tower may be operated the year round.

Jumps from the tower are forbidden in the following cases: when the parts of the tower are in bad condition or the area of landing is unsuitable; when there is no instructor present; when the velocity of the wind is over 4 meters per second; towers which have a non-turning console may not be used when the direction of the wind is towards the side of the console(stationary beam); in rain and when it is colder than 20 degrees C.

On the tower it is mandatory to have a first aid kit.

If it is possible, it will be advantageous to construct a metallic tower having a height up to 50 meters, instead of a wooden tower. In the planning and construction of such towers it is necessary to provide for operation throughout the year.

ORGANIZATION AND METHODS OF PRACTICING JUMPS FROM PARACHUTE TOWERS

On the tower we practice and perfect the technique of taking the initial position and preparing for leaving the airplane, and also check and improve the correctness, speed and resoluteness of the trainee in leaving the plane. Towers having a height of 35 meters or more make it possible to practice the method of making turns during the descent. The tower offers full opportunity to practice the methods of preparation for landing and the methods of landing under natural conditions, both in the daytime and at night, and also with an additional load.

For the exercises on the tower it is necessary to have 3 sets of harness with dummy parachutes, a suspension system for the training in the execution of turns and a packed practice parachute.

For making the jumps, the suspension systems(harness) should have packs of the main and reserve parachutes with the cushions on them.

The purpose of the exercises is to enable the trainees to develop skill in all the movements of the jump and landing, and also the practical checking of the preparation of the trainee for a jump from an airplane.

Before we allow the trainee to jump from the tower, we should check to see how well he knows the theory of the elements of the jump.

The footwear for making the jump from the tower should meet the same requirements as in jumps from an airplane.

Before practicing all the elements of the jump together, we should execute 4 or 5 jumps on other apparatus for the theoretical and practical learning of all the elements of the jump. When there is any doubt as to mastery of the elements by the trainee, he is required to repeat the jumps until all the necessary skills have become automatic.

Before beginning of the exercises the instructor, after personally inspecting the tower and making sure that it is in good condition, reminds the trainee of the rules for putting on the suspension system and the rules for the jump; he explains the tasks which should be carried out by the trainee and the method of executing jumps from the tower. After this the instructor puts on the suspension system himself, and makes a demonstration jump. Then the trainees make their jumps.

During this time, on the platform of the tower, there are the jumpmaster instructor(evaluating the approach to the point of separation, preparation and jump) and 2 trainees with the parachute harness on them. On the ground, at the place of the landing, but at such a distance from the tower that they can clearly see the upper platform and the descending parachutist, there is the instructor--packer of parachutes (or an experienced parachute sportsman), who gives instructions to the descending trainee, assists him in unfastening the suspension system and sends the parachute to the top of the tower.

Behind the barrier, on the platform of the tower, one fastens for the next parachutist the snap hooks of the suspension system to the buckle of the shroud lines of the canopy. The instructor,who is on the tower, after making sure that the suspension system is properly attached, gives the command "Crawl out" by raising his hand and by word of mouth.

After this command, the parachutist crawls from the cabin and approaches the edge of the platform.

Upon the command "Get ready", he takes the initial position and in the first jump pulls with his hands the loose ends of the main strap. After this the position of his hands should be that which is required in accordance with the rules of the jump from the airplane, that is, his hands should be on the reserve parachute(in a jump with a parachute of forced operation--static line opening). Upon the command

of the instructor "Go", the parachutist, by a light push, leaves the tower with his feet downward, with a slight inclination of the body forward. After leaving, he gives the rip cord ring of the main parachute a sharp jerk, if he jumps with a parachute of the free action type, and after the opening shock he raises his head and inspects the parachute. During the descent the parachutist keeps his legs together and holds them in a semi-bent position, with a slight thrust forward(in case of an incorrect position of the legs with respect to the ground the proper commands are given).

The instructor, observing the execution of the jumps from the tower, should evaluate them from the following points of view: how correctly and quickly all the actions are made in preparation and in the jump; how calmly and deliberately the jumper executes all these movements, whether or not he has any fright at the moment of jumping from the tower and whether or not he makes any mistakes because of excessive nervousness; whether or not he jumps correctly from the tower and pulls the ring in time; how correctly, quickly, and precisely he makes the turns; how his legs are prepared for the landing and how he executes the landing itself.

The parachute should do all of this in the third, fourth, and fifth jumps with a rating of not less than "good".

Table 12 (page 12)

Serial No.	Name	Ser.No. of jump	Rating of prep.	Rating of leaving platform	Rating for pulling ring	Rating for turn	Rating for landing	Total
1	I.V. Sidorov	1	good	hesitating	too soon	good	legs apart	satisfactory
		2	"	satisfactory	good	"	good	very "
		3	"	good	good	"	"	good

The instructor should keep a record of the execution of the elements of the jumps in the approximate manner shown in table 12; if the parachutist shows indecision, delays on the platform and does not jump at the first command, the instructor gives a second command. The raising of the voice, laughter, and pushing are categorically forbidden. In the case of a trainee who cannot make up his mind to jump, one has him to take additional training on the dummy airplane, on the suspension system, on the "movable net" and the "giant steps".

After all the trainees of the group have executed one jump each from the tower, the instructor conducts a critique of the work done, gives a general and individual evaluation, points out to each one his mistakes and also how to correct them.

Subsequently, after each repeated jump of all the group, the instructor gives a critique, pointing out the weaknesse and how to remove them.

In the course of all the training process, the instructor studies the conduct of each trainee (is he resolute, confident that he can execute the jump), does he follow strictly the rules of discipline and execute strictly all the rules of the jump. One should not allow the trainee to jump from the tower more than 2 or 3 times a day.

In the training process the trainees should master perfectly the command -signals for preparation and leaving the airplane, the rules for preparation, climbing out and jumping, pulling of the ring, inspection of the canopy, rules for determining the drift and method of making the turn(if the instructor teaches this), preparation for landing and the method of landing.

Remark. It is erroneous to suppose that the parachutist who does not have an opportunity to make jumps from the tower cannot be allowed to jump from an airplane. Very careful preparation on some other training apparatus, with an increase in the time of the ground practice of the steps of the jumps, can make up for the absence of training on the parachute tower.

AERIAL CABLE TRACK

The aerial cable track is one of the training devices of the parachute camp, tobe used for teaching the elements of the jump(figure 136).

On the aerial cable track the trainees practice the elements of the parachute jump such as jumping from the airplane, inspection of the canopy of the parachute after it opens and the arrangement of the leg straps of the suspension system, the descent, the turns during the descent, preparation for landing, landing, clearing oneself of the suspension system after execution of a jump over water and in strong wind, preparation for landing and landing itself with weapons and equipment.

The aerial cable track consists of the following basic constructional units and equipment: the main tower with the standing platform and the platform for inspection and ladders, the tail tower with the inspection platform and the ladder., carrier and traction ropes with 2 carriages, anchor struts with the "forkops"(1)

(1) Trans. Note: Apparently means the cable head.

of the main and tail towers, transition pulleys of the carrying and traction cables, fastened to the main and tail towers.

Remark. The parachute suspension systems for releasing (lowering) the parachutist with the aerial cable track should have mounted on them dummy main and reserve parachut

Both towers of the aerial cable track are metallic. One of them(the main one) has a height of 18 meters and the other, the tail tower, has a height of 5 meters. Both towers are connected with each other by 2 pairs of carrier cables. Along them there move 2 carriages , to each of which there is fastened a suspension system for the descent. The masts are at a distance of 100 meters from each other. One end of the carrier cable is fastened to the main tower at a height of 18 meters and the other is fastened to the tail tower at a height of 5 meters.

The main tower, with a height of 11 meters, has a standing platform from which the parachutists are released, one after the other from the right and left sides. On the standing platform there is a brake by means of which the instructor can give to the carriages the desired speed or stop their movement entirely. With each truck intended for the parachutists there is the same kind of brake.

The trainee goes up on the tower by means of ladders placed around the main tower.

The main tower and the tail tower can be disassembled. In the lower part the moving carriage has a circle with a diameter of 2 meters, to which there are fastened the shroud lines of the suspension system. Before the release the circle may turn and be set under any angle to the line of movement, that is, the descending parachutist may be let down under any angle to the line of his descent(sidewise, face foreward, backward, etc) and at the moment of the taking of the initial position for landing he should turn his face quickly in the direction of movement.

The speed of movement of the parachutists (the final) is 4--5 meters per second, but if this speed is not sufficient it can be increased by fastening the cables to the tall tower at a height of 3 meters instead of the usual 5 meters. When we fasten the cables at a height of 3 meters, it is necessary to make a depression in the ground, otherwise the parachutist will land quite a ways before arrival at the tail tower, shortening in this way the path and the time of descent.

The fastening of the cables to the main and the tail towers is done by means of a dead-eye and clamps.

In the absence of a main tower and a tail tower the carrying cable can be connected by means of special hooks to any building or structure of sufficient height.

For the installing of an aerial cable track it is necessary to have an area of at least 140 x 35 meters.

METHOD OF ORGANIZING AND CONDUCTING THE JUMPS FROM THE AERIAL CABLE TRACK

For the organization and execution of the jumps from the aerial cable track there are appointed a director of jumps who is responsible for all the training process, a jumpmaster for the trainees on the main tower, who is on the platform of the main tower (the instructor parachutist) and a person to meet the jumpers who land, who is at the place of the landing at the tail tower(a sportsman parachutist or parachute packer).

Before allowing the students to jump, the director of the exercises explains to them the task and makes a demonstration jump(descent) or entrusts the execution of the jump to one of the parachutist instructors. After this the next jumper, after putting on the suspension system at the tail tower(just as the trainees after the release and landing takes off at the same place his suspension system, and the next jumper puts it on), goes to the main tower, climbs to the standing platform and reports to the jumpmaster that he is ready for the jump.

The jumpmaster, first fastening himself with the safety strap to the girder of the tower and checking the correctness of the fit of the suspension system to the trainee, briefly instructs him concerning the rules for the execution of the task. After this he gives the command "Get ready". The trainee approaches the edge of the platform, fastens, with the help of the jumpmaster, his suspension system to the parachute system of the carriage and takes the initial position for the jump: squatting slightly, he holds his feet together, inclining his body slightly forward, his hands on the reserve parachute. The jumpmaster gives the order "Go" and the trainee smoothly leaves the platform.

After starting to descend, the jumper arranges the leg straps of the suspension system and places himself in the correct position for descent. Upon approaching the ground he places his body and legs in the correct position for landing. After landing the suspension system of the trainee is unfastened from the parachute system.

After having the trainee practice without a turn, the director gives the command --fasten the carriage at 90° to the direction of movement and practice descent and landing with a turn on the suspension system in the direction of movement. After this

the trainees practice landing with turns of 180°.

In case of an increase in the speed of descent, upon the command of the director, the trainee must employ the brake.

In order that the jumper, after the landing (due to inertia or if his legs are drawn up), may not strike the tail tower, it is necessary to stretch before him on 2 posts 4 or 5 cords of aviation shock absorber.

The ground at the place of the landing should be loose.

RECORD OF THE OPERATION OF THE AERIAL CABLE TRACK

From the moment one starts to use the aerial cable track one should keep a record of its operation in a booklet kept in the aeroclub to which the aerial cable track belongs. In the booklet one should record the following: the date of the setting up and release of the cableway for use, the date of acceptance for use and the number of the acceptance document, the dates of all the periodic and prejump inspections , the number of descents executed during each exercise, the number of the different finishing touches and repairs with a notation of the results of the tests after repair.

Once a month the parachutist instructor must check to see how the records are kept in the booklet and the results of the check should also be written in the booklet.

Before making the jumps, the director must inspect the aerial cable track in accordance with the instructions and record the results of the inspection in the booklet. Without a record of inspection of the aerial cable track in the booklet of the director of jumps it is forbidden to make jumps from it.

METHOD OF INSPECTING AND LUBRICATING THE AERIAL CABLE TRACK

The director of the exercises, who inspects the aerial cable track, must determine the condition of the towers of the carrying cables in the vertical plane, check the condition of the fastening clamps, inspect the struts and their fastenings to the anchors, i.e., the fastening of the clamps of the cable to the construction and anchors, and the condition of the "farkop"(cable head?)

The director inspects the ladders, the balustrades and the platform of the towers, checks the condition of their fastening, the running parts of the carriages--the condition of the fastenings of the carriages to the suspension system and the condition of the fastening of the strut bolt. He checks the strands and the threads of the carrying and the traction cables, the transition pulleys of the carrying cables

with the aces (pins) and how well they are fastened to the tail tower.

The director must make sure that the carriage wheels on the carrying cables are in the correct position, for which purpose the carriage must be run from the upper position to the lower by pulling the traction cable from the tail tower; he must make sure that the traction cable moves properly over the pulleys to the main and the tail towers, check to see whether or not the exits for the release on the standing platform of the main tower are closed, whether or not there is a security strap on the standing platform of the main tower for the jumpmaster instructor. The working and the running parts of the aerial cable track should be lubricated regularly: the screw parts of the "farkops", the working parts of the carriage and the pins of the transition pulleys should be lubricated once a month, and the carrying and traction cables, once a week.

The carrying cables are lubricated by slowly passing the carriage from the main tower to the tail tower, using a shortened suspension system with the inspector suspended from it, and the traction cable is inspected by pulling it and looking at it from the platform of the tail tower.

At least once a month, depending upon the extent to which the aerial cable track is operated, it is necessary to make a detailed inspection of the cable track, for which purpose there is appointed a commission. In the commision there must be an engineer and a parachute instructor. The result of the inspection of the aerial cable track is recorded in the service book.

If the aeroclub has no parachute tower, the aerial cable track is the last stage in the training of the parachutist on the ground, before jumps from an airplane.

NET TRAMPOLIN

The net trampolin is an apparatus for aerial gymnastics. The employment of it in aviation makes it possible to develop and instil in the trainees will power, daring, dexterity, quickness in action, i.e., qualities which are extremely necessary for the parachutist. In the training on the net trampling the trainees develop the body in an allround manner(figure 137).

The net is stretched by means of rubber shock absorbers between posts specially placed for this purpose.

In practice on the net, the trainee jumps a distance of 2--3 meters or more, and when he is in the air he can make the different figures: somersault, turns, fall with the face down, fall on the back etc.,

While exercising, the trainee should use a waistband support in order to insure him against injury in case of falls.

Exercises on the net trampolin have an effect upon the respiratory organs and the heart. Hence, they should be conducted under the supervision of a physician and in the presence of an experienced physical culture instructor. In the summer the exercises take place in the open air. In the winter they may be transferred to indoors, in rooms with ceiling 7 meters above the floor.

The training on the net trampolin is conducted in accordance with a special program. It enables the trainee to learn to give his body the desired position in the air during a free fall and in case of falling in a position which is unfavorable for the opening of the parachute. This training is particularly important for one preparing for jumps with delayed opening of the parachute.

Jumps from elevated places, "giant steps", and other kinds of apparatus train the muscles of the leg of the trainee for landing.

In all cases of training and on any kind of ground apparatus, it is necessary to take all necessary measures for technical safety.

THE PHYSICAL TRAINING OF THE PARACHUTE SPORTSMAN

The ground training of the parachutist consists not only of training him on special parachute apparatus but also of an all-round physical training.

If we are to become good parachute sportsmen and carry out the most varied kinds of jumps, we cannot limit ourselves to the learning of the parts of the parachute, the rules for the execution of the jump and other matters of parachute training. For this purpose it will not suffice to make just a few jumps in a parachute. In the absence of sport improvement the parachutist cannot carry out the complicated parachute jumps, for example, jumps for precision in landing, where it is necessary to expend a great deal of physical energy in slipping. Stunt jumps, with delayed opening of the parachute, altitude and speed jumps require of the parachutist still greater expenditures of psychic and physical energy.

There are cases when, in the winter time, after the parachutist lands, it takes him a long time to collapse the parachute and stand on his feet. This is explained by the fact that the parachutist has already expended all of his physical energy in the execution of the jump and what he has left is not sufficient for the final

stage. This means that the parachutist does not devote the proper attention to his physical training.

The ground training of the parachute sportsman, especially in the parachute camp, should be combined with physical training.

The physical training of the parachute sportsman consists of special training exercises: gymnastic swings, gymnastic wheels, net trampolins, pole vaulting. One should also include running over rough terrain, the overcoming of natural and artifical obstacles, jumping over them, standing jumps, high jumps from suspended positions, broad jumps and running jumps, climbing poles and ropes etc.. Each parachute sportsman should be able to swim well and know the methods for rescue on water.

For this purpose, in addition to the apparatus listed above for the parachute camp, it is necessary to have in the aeroclub other sport apparatus such as gymnastic swings(138), parallel bars, rings, gymnastic wheels(139), ropes for climbing etc.,

The sport requirement makes mandatory the passing of the test "Ready for work and defense, first stage" for sportsman parachutists of the third class; the passing of the test "Ready for work and defense second stage" for sportsmen parachutists of the second and first sport classes; and the passing of the test "Ready for work and defense, second stage with rating of "expert" for masters of parachute sport.

The basic method for conducting the physical training of parachutists is the practice-training exercise. The basic exercises (the methods and actions) and training should be conducted in the following sequence: getting acquainted with the exercise, learning the exercise thoroughly and practicing and developing the exercise.

Especial attention should be devoted to development, in the trainees, of endurance by a gradual increase in the intensity of the exercises and a gradual increase in the complexity of the situation of the exercise and the conditions under which they are conducted(rougher terrain, natural and artificial obstacles, transition from sport uniform to the uniform of the parachutists etc).

Sport games and participation in team contests will develop a feeling of collectivism, a feeling of mutual assistance, the will to victory, self-control and endurance.

THE ORGANIZATION AND THE METHOD OF CONDUCTING LOCAL FLIGHTS AND DEMONSTRATION JUMPS

The day before the trainee is to execute his first jumps from an airplane, he must make a local flight in an airplane of the same type from which he will make his jump

and with mandatory donning of the parachute. In the local flight the parachutist instructor and the physician will observe the trainee.

Usually, there will be one flight consisting of 2 circles over the airdrome, lasting for 6 to 10 minutes, at a height of 400—500 meters. For certain persons the local flight may be repeated.

Before the flight one should explain briefly to the trainee the basic aviation-tactical characteristics of the airplane on which they will make the local flight and from which later on the trainees will make parachute jumps.

Before this flight the trainee should be well acquainted with the rules for approaching the airplane and boarding it, the measures of precaution in taking his place, the method of placing himself in the airplane, the rules of conduct during the take-off and during the time of flight in the airplane, and, finally, he should clearly know the method of executing the signals established for the normal jump from the airplane and for the emergency jump.

The pilot, after having gained the required altitude for one circle, should, on the second, fly out on an operational course lasting 40—50 seconds to the selected place of the jump, cut off the gas and, while gliding, show the parachutist the manner of flight during which he just take the initial position and at what point(a signal placed on the ground) he must jump from the airplane.

On the ground, when the engine is running at a low rate of revolution, the instructor orders the trainee to take his initial position for the jump, imitating as closely as possible the actual situation under which the trainee must execute the parachute jump.

In the air, throughout the local flight the instructor observes how the trainee feels and acts; and after this on the ground after the flight, the physician does the same thing. As a rule, we observe in those who fly for the first time a change in feeling accompanied by a number of external symptoms. In the majority, one may observe an excited animated condition, increased mobility and good humor after the flight. In certain persons there appears a distrust and a fear and sometimes even nausea and vomiting. In the case of such persons it is necessary to have special observation, and the majority of them will prove to be unsuitable for parachute jumps.

Hence the preliminary local flights give to the instructor and the physician a clear idea as to the degree of preparation of those who are taken up and concerning their

nervous-psychic condition during the time of the flight. The instructor, after comparing the appraisal of the flight with the preceding appraisals given for the trainee during the theoretical and practical ground training, gives a general conclusion concerning the preparation of the parachutist for the jump.

At the airdrome, during the local flights, the parachutists, while awaiting their turns, learn the methods for collapsing the parachute after the landing and how to put it into the bag.

Before the beginning of the execution of the jumps, and also before each new exercise, one should make demonstration jumps. The demonstration jumps are executed by parachute instructors, instructor-packers or experienced parachute sportsmen, strictly in accordance with the preceding exercises and with the same type of parachute and method of opening with which one planned the jumps with the group.

Before the beginning of the demonstration jumps, the instructor gives instructions to the executors of them and determines the sequence of the execution of the separate elements of the jump. In illustrating a given element of the demonstration jump, the instructor explains to the trainee how to proceed.

As a result of the observation of demonstration jumps, the trainees should get a clear idea of the methods of executing all the basic elements of the approaching jump.

Chapter V

ORGANIZATION OF THE CONDUCT OF PARACHUTE JUMPS

General Statement

Parachute training in the organizations of the Dosaaf is for the purpose of enabling the young man, without quitting his regular work, to get in a practical way the initial parachute training and after this to finish his training under the program for parachute sportsman and masters of parachute sport.

The parachute jumps from airplanes should be preceded by careful and allround theoretical and ground training, during which one should learn thoroughly the parts of the parachute and the special rescue means, the methods of packing the parachutes and the special rescue means, the methods of packing the parachute and adjusting it to the trainee, questions of the theory of parachute jumps, the rules and techniques for the execution of the jump, signs and signals for the staking out of the start

on the airdrome and the rules of conduct on the airdrome, the methods of forced abandonment of the airplane.

All the personnel of the aeroclub and the parachute sportsmen should learn thoroughly and meet the requirements for planning and conducting of parachute jumps and the course of training for parachutists.

Each director, in the process of training the parachutists, and especially in the making of parachute jumps from an airplane, should serve as an example in organization, discipline, a model of precise execution of all the elements of parachute training and excellent knowledge of this subject.

The training of the parachutists should be conducted in a consistent manner, with gradual transition from the learning of the simple elements of the jump to the more complicated parts.

Before allowing the trainee to make parachute jumps it is mandatory that they have ground and pre-jump training.

The ground training is conducted on the ground training apparatus of the parachute camp.

The pre-jump training is conducted on the airdrome before the actual jumps. In this training the instructors explain the task to the trainees, remind them of the rules for what they are to do and the basic elements of the jump to be executed. After making sure that the rules for the execution of the approaching exercise have been mastered by the trainees, the instructor, in accordance with the planning schedule, explains the sequence of the jumps. The instructor should conduct the pre-jump training in accordance with a previously prepared plan.

After the trainees have had the initial theoretical and ground training, local airplane flights are made. If the parachute jumps are executed not from an airplane but from a balloon, one must make a control ascent in a balloon.

PLANNING OF PARACHUTE JUMPS

The basis for the planning and conduct of parachute jumps is the order of the chief of the training organization and the approval by him of the planning schedule for flights and jumps. The order should give the place and time for conducting the jumps, the purpose and tasks of the jumps. The order of the chief should also appoint the director of flights and jumps, the duty physician and the start detail, and also specify the technical and transport means for serving the jumps and the

take-off zone and is marked by a circle having a radius of 100 meters, in the center of which the sign "T" is laid out by means of panels. This sign indicates the direction for the approach of the airplanes in the release of the parachutists and the direction of the wind; it indicates for the parachutist the center of the circle at the place of landing and indicates permission for the execution of the jumps. If for some reasons the jumps are forbidden, then, instead of the sign "T", we make the sign of a cross(+).

At the place of the concentration of the parachutists there should be a board for posting the weather reports and a sketch of the airdrome for the estimate of the jumps, the start, and also benches, boiling water, etc.

On the airdrome(or field) where the parachute jumps are, the flights of other airplanes(or gliders) are forbidden.

It is advantageous not to have near this place where the jumps are made any high voltage wires, railroads, buildings, marshes, forest cuttings,etc.

If near the place of landing of the parachutists there is a river or some other body of water, there should be rescue posts on it and the parachutists should be equipped with life belts.

At the place of the landing there should be an assistant surgeon with the necessary medical supplies and means of conveyance and some of the instructors-society workers in not in the capacity of duty officer on the field, his function being to give orders to the descending parachutists for correct turning and preparation for landing in case they make errors.

The total additional load of the parachutist should not exceed 16 kg.

The preparation and control of the training of the parachutists on the airdrome, before the jump from the airplane, is made by the instructor-packer under the supervision of the commander of the parachute team. The taking up of trainees for jumps on a two-seater airplane is done by a pilot who is parachute instructor and has supervised the parachutists in the initial training or, in accordance with the program, parachute sportsmen of the third class. For taking up parachute sportsmen having a sport title of the third class and above, we may employ experienced instructor aviators of the aeroclub who have had special training in flying planes with parachutists and who have had instruction in the organization and conduct of jumps.

flights.

The planning schedule for the jumps should also give the surnames of the parachutists admitted to the jumps, how many jumps the parachutists are to make, the type of parachute and its number, the task--the character of the jump, with an indication of its height, number of the airplanes on which the trainees will be taken up.

The planning schedule also has notations of the physician as to the fitness of the trainees for making jumps, notations and appraisals of the execution of the jumps.

Before enrollment in the aeroclub, all the parachutists should go before a medical board and the day before the making of the jump they should have a medical examination.

A parachutist refusing the first jump may be admitted later only on condition that he takes additional training on the ground at the parachute camp and only with the permission of the aeroclub.

All the jumps, both training and sport jumps, are made only on training parachutes in combination with the reserve parachute. The jumps may be made with both parachutes of forced opening and parachutes of manual opening, but in this case it is mandatory that one use a semi-automatic parachute.

The trainees are admitted to the jumps provided that before the jump they participated personally in the packing of their own parachute, a fact which should be attested by their signature in the service list and certificate. The instructor--packer may pack the parachute under the direct supervision of the parachute instructor only for a parachutist taking initial training and who makes his first orienting jump.

The planning of parachute jumps on the airdrome(or other areas), and also flights and layouts of the start line are carried out in accordance with the instructions for the making of flights and "Instructions for the planning and execution of parachute jumps in the training organization of Dosaaf"(Figure 140).

The place for the release of the parachutists is determined before the beginning of the jumps on the basis of weather data or by the release of registration parachutes. However, the actual suitability of the place should be checked later by jumps of an experienced parachute sportsman, packer of parachutes, or parachute instructor.

The parachutists, the parachutes and the transport are at the place for the technical means, small flags being used to mark the place where they are.

The place for the landing of the parachutists is selected to the left of the

The instructor-aviator is not allowed to take up the parachutists until a check shows that he is prepared for this duty. Permission to fly the plane with the parachutists is given by an order to the aeroclub.

The planning of the parachute jump on a special field set apart for this purpose is done just as it is on the airdrome. The field should be under continuous control and observation of the aeroclub, in order to avoid damage to their surface, and both before the landing of the airplane and before the jumps it should be carefully inspected.

THE DUTIES OF A PARACHUTIST

The parachutist must know thoroughly the parts of the parachute on which he makes the jump, the interaction of the parts of the parachute when it opens, the rules for the packing, the adjustment, operation and conservation of the parachute; he must see that the parachute is in good condition, observe the dates for repacking, personally participate in the repacking of his parachute and carefully check the parachute before the jumps. He should also know thoroughly the technique of the jump from an airplane, the technique of landing on obstacles and on water, the rules for leaving the airplane in case of a forced jump, the laying out of the start line on the airdrome(the signals and signs and the method of moving about on the airdrome).

After receiving at the start line the command "Prepare for the jump" the parachutist must fasten the pack elastics of the main and reserve parachutes, check the condition of the parachutes and the correctness of the mounting of the opening device(manual, or forced), and also of the semi automatic parachute device. In checking one should see that all the following are in good condition and properly arranged; the pack elastics (properly fastened) the suspension system, the opening devices of the main and reserve parachutes, the seal, the pin of the rip cord, the cones, louvers and the flexible hose, the pocket of the ring of the rip cord and the elastic bands.

It is necessary to check the mounting and arrangement of the semi-automatic parachute device and the static line, the line for its forced connection, and to check the fastening of it and the condition of the snap hook.

If the parachute is prepared for a jump with forced opening, it is necessary to check to see whether or not the static line is mounted correctly, whether or not it is properly fastened and the condition of the snap hook. In parachute jumps with

forced removal of the cover of the canopy, we should check the knot by means of which the connecting line is tied to the static line.

After this check, the trainee puts on the parachute with the aid of another trainee and checks the fitting of the suspension system(harness).

In the preparation for the jump, the parachutist must pay special attention to his clothing and shoes.

The best clothing for a parachute jump is the flying suit and helmet (summer or winter). If we do not have the flying suit, we can jump in any kind of suit(except the jacket suit). The suit should be smooth so that it will not catch on the canopy of the parachute with the lines or pilot parachute.

The shoes should fit properly and have low heels(not worn down at the heels). It is best to have half-boots with lacing covering the ankles and fastened by a tight cord. In jumps in shoes with low lacings or without any at all(in the case of boots), and in the wintertime in fur boots it is necessary that they fit tightly to the feet and that the boots be fastened to the flying suit so that they will not be lost in the air.

It is recommended that instructor personnel making regular parachute jumps, especially persons weighing a great deal(75 kg and above), have special footwear--half boots, with lacing extending three fingers above the ankles, with broad and strong soles, low heels and soft buffer inner soles of spongy rubber or soft felt.

One of the measures for preventing injuries in jumps is a well fitting suspension system for the parachute. A correct individual fit insures a comfortable position for the parachutist in the airplane, protects the jumper against bruises and chafing during the opening shock, free arrangement during the descent and, if necessary, the opportunity to unfasten the suspension system.

THE DUTIES OF THE INSTRUCTOR-AVIATOR TRANSPORTING THE PARACHUTISTS FOR THE EXECUTION OF PARACHUTE JUMPS.

It goes without saying that the instructor aviator should first of all master thoroughly the technique of piloting at the various speeds of flight.

Before the parachutist boards the plane the pilot should check, by an external inspection, the parts of the parachute of the jumper, the mounting of the opening device for forced opening of the parachute, the jumper's knowledge of the basic rules for the jump and remind the jumper of the rules for the employment of the reserve

parachute in case it is necessary.

In piloting the airplane, the pilot should not make steep banks or abrupt changes in speed and in approach to the point of jump [illegible] should keep the airplane precisely at the required height and speed.

It is absolutely necessary that the instructor-jumpmaster know how to release the parachutists, the weather situation and how to [illegible] the area for the drop and the landing. The commands "Crawl out", "Prepare" and "Go" should be given in time. One should not keep the parachutists too long on the wing during the approach to the place of the drop; instead, one should reduce it.

In bringing the parachutists up we should select an altitude of 50-80 meters above that specified in the program for the given jump, so that when the pilot cuts off the gas and begins to glide (the moment the jumper leaves from the plane and takes the initial position) the altitude at the place of the drop of the parachutist will not be less than that prescribed.

In flying to the landing place after the jump, one should carefully inspect the air over the place of landing in order to avoid a collision of the airplane with the parachutists who are descending or landing.

PREPARATION OF THE PARACHUTISTS AND THE PARACHUTES FOR THE JUMP

The parachutists, with their parachutes, gather on the airdrome not more than an hour before the beginning of the jumps.

The parachutes are transported on a chest-type vehicle, covered with an awning, and are arranged in a place assigned for this purpose.

After the general command, one takes the main and reserve parachutes from the sack, and after the pack elastic bands are [illegible]ed, places them in a pyramid, with the lower flaps on the awning(with the loops [illegible] of the suspension system upward), in such a way that the parachutes rest against each other. The bags are folded and placed on the main parachute. If there is no building to serve as a floor, the parachutes are placed on folded bags.

The instructor-packer, walking along the parachutes placed in the form of a pyramid, checks the condition and the arrangement of the elastic bands and the opening device(the ring, rip cord, pins, cones, louvres, textile line, snap hooks etc.).

When a parachute is put on the next parachutist, the packer again makes an external

check of its condition and the correct [illegible].

The instructor-packer should also [illegible] tightness of the fastening of the parachutes to the trainees, the time of [illegible] of the packing and the correctness of the record kept on the service list. [illegible] results of the inspection of the parachutes in a special notebook. [illegible] the parachutes, the instructor-packer must pay attention to the suitability [illegible] headgear, the outer clothing, the shoes of the jumper and the requirements [illegible] to meet.

THE PLANNING OF THE CONDUCT OF THE JUMPS.

The method of planning the conduct of [illegible] jumps should correspond strictly to the instructions and requirements [illegible] instructions for the planning and conduct of parachute jumps and the [illegible] ing for parachutes.

Jumps are permitted in the European [illegible] Soviet union at temperatures not lower than minus 20 degrees C, in East Siberia [illegible] Far East, not lower than minus 30 degrees C, with a strength of wind [illegible] at the altitudes which are given for the exercises specified by the [illegible] ally, the strength of the wind on the ground should not exceed 6m/sec. [illegible] jumps may be made if the snow cover is not less than 15cm.

The director must secure the necessary [illegible] concerning the weather in the area of the jump and maintain regular [illegible] with the weather station.

The height of the jump should not be [illegible] meters. From a balloon the training parachute jumps of forced action [illegible] made from a height of not less than 600 meters. Instructor-parachutists [illegible] of parachutes may execute jumps from an airplane from a height of [illegible] masters of parachute sport from a heigh of 500 meters.

Aviator glasses are employed only in [illegible] long delay in opening of the parachute. Before landing the glasses should be taken from the eyes.

Upon arrival at the airdrome with the [illegible] carry out a pre-jump preparation, after which they prepare [illegible] for their jumps.

The instructor-parachutist checks to see if the [illegible] are on the list and the planning schedule, and then explains to them the purpose and the task of the exercise, reminding them briefly of the main rules for their action and the method of employing the reserve parachutes. He explains to them the meteorological report, the

course of the airplane for the drop, the place the jumpers leave the airplane, the direction of the drift during the descent and the characteristic landmarks.

After this the instructor explains the sequence of the jumps and checks the condition of the uniforms of the jumpers.

After checking and briefing the trainees, the director of jumps gives the command: "Prepare for the jump", after which the next parachutist, after inspecting his parachute, with the help of the next parachutist or packer, puts on the parachute.

The packer again checks the condition of the parachute and how it is fitted (one checks by external inspection the condition and correctness of the mounting of the elastic straps of the main and reserve parachutes, the mounting of the opening device; the ring, rip cord, pins, cables, harness, mounting of the static line, condition of the snap link etc.)

After the check, the parachutist reports to the physician and then to the jump director that he is ready for the jump.

The report should be brief and precise. The parachutist gives his surname, sport title, group and surname of the instructor-parachutist, the serial number of the jump and the name of the exercise.

After receiving the instructions of the jump director, the parachutist goes, in company with the instructor-packer, to the airplane.

The approach and boarding is carried out on the left side (the airplane Po-2). The trainee approaches the airplane and reports to the transporting instructor: "Trainee Ivanov is ready for executing a Ivanov's parachute jump". (The approximate scheme of the report).

The protective flap of the main parachute, which is placed on the trainee, should be unfastened for inspection of the parachute by the aviator-instructor.

The instructor again makes sure that the parachutist and the parachute are ready for the jump, gives the order "Take your seat", after which the parachutist, with the help of the packer, carefully, so that his parachute will not catch on some part of the airplane, takes his seat in the front cabin.. The packer first fastens the protective flap of the main parachute.

The parachutist boards the airplane in the following manner: Having placed one foot on the wing near the fuselage, the parachutist should take hold of the edge of the

cabin with his hands and, lifting himself up, place his other foot on the plywood part of the wing of the airplane and go to the front cabin. Taking with his left hand the left column of the wing center section, he brings his right foot over the edge of the front cabin and places it on the seat and after this, having taken hold of the right column of the wing center section with his right hand, he brings his left foot over the edge and places it also on the seat, after which he cautiously takes a seat at a half turn on the right side.

If the jump is executed with a parachute of forced opening, then, before taking his place in the cabin of the airplane, the parachutist must give to the transport instructor the snap hook of the static line for fastening to the special clasp.

After taking his place in the airplane, the parachutist, in answer to the question of the instructor "Are you ready", should answer "Ready", if he is sure that he is ready to make the jump.

During the boarding of the airplane and during the flight, the instructor observes the conduct of the parachutists in the cabin on the column of the wing center section. For execution of the jump three orders are given: "Climb out" "Prepare" "Go". Upon the command "Climb out", the parachutist quickly climbs from the cabin on to the wing and take the initial position for the jump.

Upon the command "Prepare", the parachutist turns his face to the tail of the airplane and takes the initial position. If he jumps with a parachute of manual opening he takes hold of the ring of the main parachute with his hand. Upon the command "Go", the parachutists leaves the airplane.

The sequence of the preparation of the group of parachutists for the jump is the same as for the individual parachutist, with the exception of the following peculiarities.

Upon the command of the director, the group of parachutists with their parachutes arrange on the start line in ranks with intervals of an outstretched arm. The inspection of the parachutes, devices and the medical observation are carried out in formation.

Upon the next command, the group goes to the airplane, for boarding in single file formation. The leading parachutist will be the one to make the last jump.

After the exploring of the group in the order of the sequence of the jumps, the instructor-parachutist, who is on board the airplane as a jumpmaster, must attach to the special cable the snap hooks of the static line, if the jump is executed with a

parachute of forced opening, or the cord of the parachute devices, if the mounting of the devices makes their connection mandatory.

After having made sure that everything is prepared, the jump master instructor reports readiness to the commander of the plane. After the checking of readiness, the commander of the airplane executes the take-off.

After the completion of the jump, the director, with the trainees, carries out a critique, dwells on each jump separately, giving an appraisal of each parachutist. The appraisal of the jumps made is usually given on the basis of the following indexes:

"Excellent", if the parachutist freely and without any delay climbed from the cabin of the airplane on to the wing, took the initial position for the jump, precisely and quickly executed the commands of the instructor, correctly left the airplane, pulled the rip cord ring for the opening of the parachute at a distance of 5--10 meters from the airplane(if he jumped with a parachute of manual opening), correctly turned in the air in preparation for landing and landed correctly.

"Good", if the parachutist opened his parachute in time and landed successfully, and met the other requirements with slight deviations.

"Satisfactory", if the parachutist delayed in crawling from the cabin, and in leaving the airplane, after the giving of the command "Go", executed an incomplete turn down wind at the time of landing.

"Unsatisfactory", if the parachutist hesitated in climbing out and leaving the airplane, opened the parachute too late or too early, did not execute the turn down wind and landed incorrectly.

The appraisal of the jump should be explained to the trainee and recorded in the journal and book containing the records of the jumps.

THE MEDICAL SUPERVISION OF THE PARACHUTE TRAINING

The task of the medical supervision of parachute training includes the following elements:

-the recruiting (medical selection) by the aeroclubs of physically sound persons fit for executing parachute jumps;

-yearly medical examination of the parachute sportsmen and of the instructor personnel;

-medical supervision of the ground training of the parachutists.

Systematic study of the condition of the health of the parachutist, timely discovery of any changes in it, the employment of therapeutic measures, which should be carried out jointly with the director;

-organization of the medical supervision during the conduct of the parachute jumps;

-study of the influence of parachute jumps on the health of the parachutists and the application of medical-prophylactic measures;

-scientific investigation work in the study of the problems for the conservation of the health of the parachutists and for the working out of prophylactic measures.

A parachute jump causes in a man a number of physiological changes connected with his emotional experiences in the preparatory period and at the moment of the execution of the jump. Depending upon the condition of the health of the parachutist, his psychological stability, preparation and training, the degree of these symptoms will differ sharply. At the first jump they are much stronger than in the following ones. In the case of well prepared parachutist physical culturists, well-trained, having confidence in the reliability of the operation of the parachute, the phenomenon of fearful expectations is rarely encountered. Men who are poorly trained, having no confidence in themselves, are buried in meditation, seclude themselves and sleep poorly a long time before the jump.

Even at the start, before the boarding of the plane, we observe a quickening of the pulse beat of the parachutist and a rise in the blood pressure. In the majority all these phenomena are intensified upon boarding the plane and in the flight reach their maximum at the moment of the command "Prepare", when even the breathing reflexes are slowed up, but as a rule the parachutist overcomes this.

After the opening of the parachute the frame of mind of the parachutist changes sharply, especially in the case of those who jump for the first time. The parachutist feels a great deal of excitation and often forgets to prepare for landing in time.

Thus, the organism of the parachutist, during the time of the execution of the jump, undergoes great changes, and all those enrolled in the aeroclub should pass a strict medical examination.

The pre-jump medical examination, by which one determines the advisability of admitting the trainee to the approaching jump, is of great importance. The pre-jump examination is carried out by the physician the day before or on the day of the jumps.

The period of validity of the medical examination before the jump is 2 days.

The medical observation of the trainee should be conducted during all the period of his training, and on the basis of this, and also on the basis of the observations of the parachutist instructor one determines the question as to whether or not the trainee may be allowed to jump.

The medical selection of the candidates for parachutists is carried out before the beginning of the special parachute training, that is, in the period of the recruitment of the group.

For making these selections we appoint a medical commission consisting of a therapeutist, surgeon, urologist, otolaryngolist and an oculist. In the work of the commission, the participation of the parachute instructor of the groupwhich is being examined is mandatory.

In making the selection, special attention should be paid to the condition of the nervous sytem, because during the jump the main load is on the nervous -psychic system and a great effort of will is required of the parachutist. The condition of the hearing and the vestibular apparatus, that is, the organs of equilibrium, is also of great importance. The testing of the vestibular apparatusis carried out in a special revolving armchair.

The vision has no great importance, of course, for leaving the airplane, but it does play a great part during the landing. Those with poor vision and color blindness have difficulty in orienting themselves on the basis of objects and signals.

Such defects as very flat feet, excessive curvature of the legs, ordinary dislocations, defective knitting of broken bones, vicious union of bones, inguinal hernia and femoral hernia, are all obstacles to the execution of parachute jumps.

The period of validity of the conclusions of the medical commission for admission to the first jump is not more than three months.

For persons engaged regularly in parachute work(instructors-parachutists and packers), there should be constant medical supervision. The medical examination of them by the commission is carried out once a year. For persons of this group there are drawn up medical-statistical booklets like those for the flying and balloon personnel.

The candidates declared by the medical commission to be fit for making parachute jumps should be taken up in airplanes and the results also be taken into account by

the medical personnel.

The medical supervision of the parachute jumps consists of the following basic problems: medical examination the day before the jump, questioning before the jump to find out the condition of the health of the jumper, indications as to the need of medical assistance.

On the basis of the results of the medical examination, the physician gives his conclusion in the planning schedule as to the fitness of the trainee for the jump. The planning schedule is signed by the physician, and it is forbidden to make any other additions in it after the examination.

Immediately before the jump, the physician should check to see whether or not the breathing of the jumper is normal, and whether or not his clothing and shoes are suitable for the jump. The day before the jump, the person should have at least 7 or 8 hours sleep.

The physician has the right to refuse to allow a trainee to jump in case he has doubts as to the normal condition of health of the trainee.

The physician should record all his observations in a notebook and after the completion of the jumps, together with the instructor-parachutist, he draws conclusions for each trainee. Subsequently, these conclusions are employed for determining how to handle the student in the process of his training.

The medical assistance during the conduct of the parachute jumps is rendered by the medical posts on the airdrome or on the area of landing, posts which are supplied with everything necessary for rendering first aid and with a medical ambulance. In the wintertime, the duty physician and the rest of the medical personnel should have skiis.

The physician must give careful consideration to parachute injuries and take decisive steps to combat them. For this purpose he should make a systematic study of the cases of injuries, make annlyses and discover their causes.

The medical personnel should know at all times the purposes and tasks of the parachute training, "live" the interests of the aeroclub, know where and what each parachutist is doing, take an interest in the course of the training and participate actively in it.

CALCULATION OF THE DRIFT OF THE PARACHUTISTS

The correct estimate of the jump(the estimate of the drift) is absolutely necessary both in the execution of training jumps and in other kinds of jumps.

Let us consider the process of fall of the parachutist in the air. It consists of two parts: first-before the opening of the parachute, and second--after the opening of the parachute.

In the first part, the fall of the parachutist (the direction and speed of his movement after leaving the plane) depends on the direction and speed of movement of the airplane. Then, as this speed is reduced and the direction changed, the intervening winds begin to exercise their influence upon the speed and direction of the free fall.

After the opening of the parachute, the winds at an altitude begin to exercise an influence upon the drift, the drift of the parachutist being determined by the direction and force of them. (of course, if the parachutist does not exercise control of the parachute during the descent). Hence, in order for the parachutist to land at the desired place, one must, before the jump, estimate the point of the drop on the basis of the data for the strength and direction of the winds at altitudes and the time of descent of the parachutist.

The estimates for the drop are made in three ways: on the basis of the registration (spotting) parachute, arithmetically and graphically. Below we give these three methods of estimate.

ESTIMATE ON THE BASIS OF THE REGISTRATION PARACHUTE

The estimate with the registration parachute is usually made with one or two (more rarely three) registration parachutes.

Let us consider how to carry out the estimate of a jump with the aid of the registration parachute.

During the very first flight the instructor takes with him two or three registration parachutes. These parachutes are standard and have the same speed of descent, which is equal to 5m/sec, that is, it is equal to the velocity of descent of the parachutist on the ordinary training parachute.

After the take-off, the instructor gains the altitude from which the parachutists will jump, and flies out on the course against the wind in accordance with the sign "T" placed on the ground. Making use of personal experience, he selects the point

of drop and throws out the first registration parachute.

The aviator remembers the point over which the parachute was dropped and watches the descent of the registration parachute until the moment it lands. If the release parachute does not fall at the point on the ground selected for landing but deviates to one side, then he makes a correction for this distance and selects a new point of drop, in order that the second registration parachute may land at the selected place. If in the second case the error turns out to be considerable, he again makes a correction and drops a third parachute.

After obtaining the necessary results in the registration, the instructor completes the flight and at the point selected (by estimate) for the release of the parachutes he places panels, after which he renders the estimate still more accurate by dropping a test parachutist over the estimated point.

If there are no factory made registration parachutes, one can make them after the model of the pilot parachute PD-6 without spring mechanism. To the shroud lines of this parachute it is necessary to suspend a sack with an object the weight of which is calculated on the basis of the formula:

$$Q = C_x \cdot \rho \cdot S \cdot V^2$$

where Q- the weight of the sack with the object(or material);

Cx-coefficient of the resistance, which equal 0.5;

S-area of the registration parachute in meters square

ρ-density of the air at the given height.

V-the desired speed of descent of the given parachute

The weight of the load for the registration parachute having a diameter of 900mm will be equal to:

$Q = 0.5 \times 0.125 \times 0.64\ m^2 \times 5^2 = 0.9$ kg

The registration parachutes should be made of bright colors in order that they may be readily visible from an altitude.

ARITHMETICAL METHOD OF CALCULATION

The arithmetical method consists in estimating the drift of the parachutist during the time of his descent on the basis of the average wind.

The training jumps are usually executed from a height of 800 meters with a

velocity of wind on the ground of not more than 6 meters per sec.

The day before the execution of the jumps, the director makes a request of the aviation meteorological station(AMCS) serving the training organization for the making of pilot balloon observations on the day and hour selected for the jumps. On the day of the jumps, an hour before they begin, after receiving the pilot balloon data, the director should calculate the drift of the parachutist.

The method calculation is shown by the example. Let us suppose that the jumps have been scheduled for 1600 hours. At 15 00 hours one receives the following meteorological information(pilot balloon data) (Table 13):

Table 13(page 198)

Height in meters	Velocity of the wind in m/sec	Director of the wind in/degrees
0--ground	4	92
100	5.6	90
200	5.8	91
300	6.4	94
400	4.5	93
500	8.2	91
600	6.8	93
700	7.2	96
800	5.5	97

On the basis of these data we make the calculation. First of all we estimate the drift during the time of the fall of the parachutist from the moment of his jump from the airplane up to the opening of the parachute. Since this value, in the execution of jumps without delayed opening of the parachute is insignificant and does not have any great practical importance, we usually suppose that the drift in the given case isequal to 50 meters.

On the basis of the measured data, the average strength of the wind between the ground and the elevation of 800 meters will be equal to:

$$4 + 5.6 + 5.8 + 6.4 + 4.5 + 8.2 + 6.8 + 7.2 + 5.5 = \frac{54}{9} = 6 \text{ m/sec}$$

9(the number of measurements by layers)

The mean direction of the wind will be equal to:

$92 + 90 + 91 + 94 + 93 + 90 + 93 + 96 - 97 = \frac{837}{9} = 93$ degrees

9(the number of measurements made on the basis of layers)

Let us determine the time of the descent with opening of the parachute in accordance with the formula:

$$T = \frac{H-50}{V_{cp} = \text{average}}$$

Where T-- time of descent with open parachute in seconds;

H--the height of flight at the moment of the separation of the parachutist from the airplane in meters;

V_{cp} the average speed of descent with open parachute in m sec(it is usually equal to 5m/sec

50--the value determined by us for the loss of altitude during the time from the moment of the separation of the parachutist from the airplane until the opening of the parachute in meters.

Hence $T = \frac{800-50}{5} = \frac{750}{5} = 150$ sec

Let us determine what the drift will be during this time:

$$L = T \times V,$$

Where L --drift from the point of release in meters:

T--time of descent in seconds;

V--the average velocity of the wind in m/sec;

For our example the drift will be equal to:

$L = 150 \times 6 = 900$ meters

After laying off, from the point where the parachutist should land, a straight line having a length of 900 meters and in the direction of 93 degrees, we obtain the point over which it is necessary to drop the parachutist.

In the example given, due to the insignificant change in the direction of the intermediate winds, the calculation will be sufficiently precise. But, if the direction of the intermediate winds change by more than 10 degrees, this method of calculation will be inaccurate. By the graphic method we can make a more precise calculation of the drift of the parachutist.

THE GRAPHIC METHOD OF CALCULATION

The graphic method of calculation for the release of the parachutists is more

precise than the arithmetical method and differs from it in that we determine the drift on the basis of the average data for the velocity and direction of the wind not at all heights but at each interval of 100 meters height and the calculated drift of the parachute in the air, i.e., we plot its path on graph paper.

The graphic method of estimate is also made on the basis of the meteorological data obtained. As a graphic illustration we shall take the meteorological data with abrupt changes in the direction of the intermediate winds and calculate the drift of the parachutist on the basis of this data by both and the arithmetical and the graphic methods of calculation(Table 14).

Table 14(page 199)

Altitude in meters	Velocity of wind in m/sec	Direction of the wind in degrees
0-ground	4	90
100	6	110
200	8	126
300	10	138
400	12	152
500	14	174
600	12	185
700	14	190
800	10	194

Let us consider these pilot balloon data by the arithmetical method (on the basis of the method of the estimate shown above).

After calculating the average wind, we obtain 10 m/sec. The mean direction of the wind will be equal to 151 degrees. Calculating in this way we obtain the time of descent with opening of the parachute equal to 150 seconds.

Multiplying this index by the index of the average force of the wind between the ground and the altitude of 800 meters we obtain a drift equal to 1500 meters.

Employing now these same meteorological data, we shall illustrate the graphic method:

At first we determine the drift of the parachutist when he drops from a height

of 750 meters(the height of the opening of the parachute) to a height of 700 meters, for which purpose we determine the average velocity of the wind on this sector.

At a height of 750 meters the velocity of the wind will be equal to:

$$\frac{10 + 14}{2} = 12 \text{ m/sec},$$

and at a height of 700 meters it is equal to 14 meters/sec; then the average velocity of the wind will be equal to:

$$12 + 14 = 13 \text{ m/sec}$$

With an average velocity of descent of the parachutist of 5 m/sec and from an altitude of 750 m to 700 m the parachutist will drop:

$$\frac{50}{5} = 10 \text{ sec};$$

meaning that the drift of the parachutist will be equal to:

$$13 \times 10 = 130 \text{ m}$$

His drift will be in the direction:

$$\frac{194 + 190}{2} = 192^{\circ}$$

By an analagous method we calculate the drift and the direction for the other layers, i.e., from 600 to 500 meters, from 500 to 400 meters etc.

As a result of the estimate we obtain the following data(table 15):

Table 15 p.200

Layer, meters		Average velocity of the wind m/sec	Drift,meters	Mean direction of the wind in degrees
from o to	100	5	100	100
100	200	7	140	118
200	300	9	180	132
300	400	11	220	145
400	500	13	260	163
500	600	13	260	179
600	700	13	260	187
700	750	13	130	192

With the estimated data obtained we construct on a sheet of paper, by means of a protractor and a ruler, the graph of the estimate of the jump in the following manner.

On the paper we plot a point through which we draw the north-south meridian. By placing on this point the center of the protractor, we mark the direction of the wind of the upper layer investigated(from 750 to 700 meters) and in the direction of 192 degrees we draw a line on which,with the scale adopted, we lay off the path of the parachutist in the air(the drift), equal to 105 meters, and mark this point. Through the point obtained we draw a line parallel to the meridian and, placing on this point the center of the protractor, we mark the direction of the wind in the second layer investigated(700-800) meters), and in the direction of 187 degrees we draw from the point a straight line on which we mark the distance of the path of the parachutist (the drift), equal to 260 meters and continue in this way until we reach the ground.

As a result, we obtain the curve which will be the trajectory of the path of the descent of the parachutist in the air his descent from a height of 800 meters to the ground.

In order to find what the drift will be of the parachutist and at what distance from the point of landing to mark the point of release of the parachutist, and also to determine the direction of this point in degrees with respect to the meridian, the initial point on the graph should be connected by a straight line to the terminal point and on the basis of the scale its length determined in meters. For the given case it will be equal to 1310 meters.

By applying the protractor to the initial point we find the direction to the terminal point to be 154 degrees.

If we compare the data of the estimate obtained by the graphic method, with that of the arithmetical, we see that the error in the estimate of the drift of the parachutist by the arithmetical method of calculation amounted to 190 meters(1,500 meters minus 1,310 meters equals 190 meters), and in direction, to 3 degrees(154--151 equal 3). This proves that the graphic estimate is more precise than the arithmetical, when the directions of the intermediate winds in the space through which the jump is made differ from each other by 10 degrees more or less.

But, whichever method is used to calculate the drift, there will still be a dispersion of the parachutists during the jumps, caused by differences in their weight, changes in the wind both in strength and in direction, inaccuracies in jumping, delay of the parachutists in leaving the airplane, etc.

The accompanying pilot should take all this into account and introduce the appropriate corrections.

If on the basis of these methods of calculation we drop a group of parachutists, it is necessary to begin the release in such a way that half the group will be released before arrival at the point of the drop and the other half after the passing of the point of drop.

In order to make a correction for a group drop, it is necessary to take into account the speed of the airplane and the time it takes for all the group of parachutists to leave the airplane. By the multiplying of the speed of the airplane by the time it takes the group of parachutists to leave the plane, we obtain the distance traveled by the plane during the time of the release of all the parachutists.

Example. According to our estimate the amount of the drift equals 1,310 meters, the speed of the plane 160 km per hour(44.5m/sec). The time it takes the group to leave the airplane is 5 seconds.

Solution: 1. We find the distance travelled by the airplane during the time it takes to drop the group: 44.5 x 5 equals 222.5 meters.

2. Let us find the distance from the center of the area of landing up to the point of the beginning of the drop of the first parachutist of the group:

$$1310 \text{ m} - \frac{225.5}{2} = 1\,197 \text{ meters}$$

Chapter VI
THE EXECUTION OF PARACHUTE JUMPS--JUMPS FROM AIRPLANE Po-2

Jumps from the airplane Po-2 are executed from the horizontal flight of the plane, and also when it is doing stunt flying, in accordance with the rules laid down by the course for training of parachutists.

Parachute jumps can be executed with forced opening or manual opening. If the jump is executed with forced opening of the parachute, the aviator fastens the snap hook of the static line to the special hook on board the airplane.

After gaining the required height and flying out on the course, the pilot, upon approach to the point of the drop, reduces the speed of the engine and gives to the parachutist the command "Crawl out". Upon receiving the command "Crawl out", the parachutist should repeat it, take hold of the strut of the wing center section with his hands and lift himself into the cabin, making sure that he does not, by some careless movement, pull the ring of the reserve parachute(Figure 141). After this,

he should place his right foot on the seat and get up, bending over in order not to touch the wing center section with the main parachute and with his head. He shifts his right hand from the strut to the back edge of the border of the front cabin, puts his left leg over the left side of the cabin, placing it on the reinforced area on the"plane surface"(or trap) and then brings his right leg over the edge also (figure 142). While holding to the edge of the cabin, he should pass along the fuselage to the rear cabin.

The aviator-instructor observes the actions of the parachutist and the position of the static line. While holding the line in his left hand, he passes it over the head of the parachutist(Figure 143).

When the parachutist reaches the second cabin of the airplane, the instructor gives the command "Prepare". The parachutist repeats the command and, making a turn to the right under an angle of 45 degrees with respect to the fuselage, of the airplane, he assumes a stable position and awaits further commands. He then places his right hand on the reserve parachute in such a way that the ring of the reserve parachute will be under the palm of his hand, and with his left hand he holds the edge of the cabin(Figure 144).

After checking again the readiness of the jumper, the aviator-instructor, flies the airplane to the estimated point and gives the command "Go". After repeating the command, the parachutist leans his body forward, removes his left hand from the edge of the cabin, shifts it to the reserve parachute and presses the parachute to himself. Making a step forward with his right foot he leaves the airplane, after which he brings his legs together.

In a jump with a parachute of manual opening from the airplane Po-2, he climbs from the cabin of the airplane in the same way as in the case of a jump with a parachute of forced opening(static line opening).

Upon the command "Prepare", the parachutist, repeating the command aloud, takes hold of the ring of the main parachute with his right hand, and, making a turn to the right under 45 degrees to the fuselage of the airplane, he awaits further commands.

The execution of the command "Go"(leaving the airplane) is carried out just as in the case of a jump with a parachute of forced opening(Figure 145).

After complete separation from the airplane, the parachutist by a sharp jerk with the right hand in the direction towards his right thigh pulls the ring and then shifts his hand to the reserve parachute.

In making jumps with manual opening, we attach to the parachute a semi-automatic device. Before the parachutist boards the plane, the instructor-aviator checks the setting of the device and the correctness of its mounting on the parachute, and in the air, at the moment the parachutist climbs from the cabin and takes the initial position, he checks position of the static line for the forced switching on of the device.

When the parachutist executes the jump with his weapon, it is necessary to adjust the weapon to him carefully and fasten it securely. In boarding the plane, climbing out and jumping from it, the parachutist must see that his weapon does not catch on any kind of object.

The instructor-airman taking the men out for a jump executes the flight with his personal rescue parachute on. This holds for all the pilots carrying parachutists up for jumps, regardless of the type of airplane.

JUMPS FROM THE AIRPLANES UT-2, YaK-18 and AN-2

For jumps from airplanes UT-2 and Yak-18, we admit sportsmen parachutists who belong in the sport category.

The parachute jump from these types of airplanes are executed from the rear cabin (the second), both in horizontal flight and from an airplane doing stunt flying, with parachutes of manual opening, with employment of the semi-automatic parachute device with forced operation(switching on).

When the parachutist boards the airplane, the end of the static line with the snaphook is handed to the aviator from the second cabin into the first: on the airplane UT-2-on the left along the fuselage, on the airplane YAK-18-under the glass cover over the cockpit of the cabin, and the aviator connects it by means of the snap hook to the lower buckle of the left waist strap.

After gaining the desired height and flying out on the course, the aviator, in the approach to the estimated point of the drop, reduces the speed of the engine, puts the airplane into gliding flight and gives the order "Prepare".

Upon the command "Prepare", the parachutist should do the following:

-arise, holding to the edge of the cabin with his hands, get up on the seat, turn around, place his face towards the left "plane", put his left kneeeon the edge of the cabin,and rest his other foot on the seat;

-after fixing himselfin a firm and stable position, he brings the reserve parachute over the edge of the cabin of the airplane, takes hold of the ring of the main parachute and awaits the command;

-upon the signal of the aviator "Go", the parachutist, by a sharp push with his hands and feet, leaves the airplane in the direction of the rear edge of the wing, and, after separating completely from the airplane, he pulls the ring of the rip cord of the main parachute and brings his hand to the reserve parachute.

Before making jumps from the airplanes UT-2 and YAK-18, it is necessary first to prepare them for jumps by carrying out the following work.

In the case of the airplane UT-2: take out the rods of the folding border of the cabin; in the rear cabin take off the handle for control of the airplane; disconnect the fire cock; take off or cover with a shield the levers for control of the engine.

In the case of airplane YAK-18: take off the movable part of the glass cover over the cockpit and the handle for the control of the airplane in the rear cabin, disconnecting and muffling the air duct; take off the levers for controlling normal gas, the altitude corrector and the fire cock; the cock for control of the shields should be fixed in the rear position. In the case of both airplanes it is necessary to place a cushion in the bottom of the seat and fasten it.

Jumps from multiseater planes of the type Li-2 and AN-2 are executed from doors, both with parachutes of manual opening and parachutes of forced opening(static line).

For the execution of jumps with parachutes of forced opening in airplanes Li-2 and AN-2, within the fuselage, over its length, we stretch a cable to which we can hook the snaps of the static lines of the parachutes. The snap hooks of the static lines of the parachutes are fastened to a cable in the airplane(with a spring from the exit door) by the instructor who is with the parachutist in the cabin of the airplane.

It is much more convenient and simple to make a parachute jump from airplanes of such types than from the two seaters: the parachutist does not need to climb from the cabin of the airplane on to the "plane"(wing) but simply goes to the door, and jumps

without making any excess effort. The instructor, who is not busy piloting the airplane and who is in the cabin of the plane together with the trainees, can observe them much more conveniently, check and determine their readiness for the jump.

In the airplane the parachutists are placed in the order of sequence in which they make their jumps. Upon the signal of the commander "Prepare"(a prolonged sounding of the siren) the parachutists get up, place themselves in the order of the sequence of the jump with their faces towards the door and prepare for the jump.

If the jump is executed with the forced method of opening the parachute, the first jumper approaches the door of the airplane places his foot on the threshold near the back edge of the door, keeps his left hand on the left flap of the reserve parachute, places his right hand on the protective flap of the reserve parachute and presses the reserve parachute to himself, slightly bending his body so that in leaving the airplane he will not strike his head or the main parachute against the upper edge of the door. In executing the jump with the parachute of manual opening, the parachutist takes the same initial position but with his right hand he takes hold of the ring of the rip cord of the main parachute.

Upon the signal "Go"(two sharp signals of the siren), the parachutists jump at the intervals fixed for them in each separate case. In jumping it is necessary to execute an energetic push in a direction parallel to the wing of the plane.

In jumps from airplanes flying at a speed of more than 200 km per hour, the push at the door (spring from the door) must be sharper.

Whatever the method used in leaving the airplane, the parachutist should remember that the main thing consists in knowing how to coordinate the angle of the incline of the body with the force of the push, the greater the angle of incline of the body, the weaker the push should be. The direction of the push should coincide with the axis of the body. A failure to observe these requirements leads to turns of the parachutist in the air after leaving the airplane.

The jump-master -instructor, upon the signal "Get ready", should stand near the rear edge of the door and supervise the correctness of the taking of the initial position and the jump of the parachutists, and also the actions of the parachutists after they leave the plane.

He may forbid a parachutist to make a jump if he discovers indecision before

jumping from the airplane, and also if the parachute is out of order, or if any of the devices or his uniform are not as they should be.

In jumps from a multiseater airplane, the estimate of the jump is made by the commander of the crew or by the navigator.

ACTION OF THE PARACHUTISTS AFTER LEAVING THE AIRPLANE

Opening of the Parachute

After complete separation from the airplane, the parachutist, by a sharp jerk of the ring of the main parachute in the direction towards his right thigh, opens the main parachute. If, however, he jumps with a parachute of forced opening, then this is done for him by the static line.

But in both cases there is an abrupt braking of the fall of the parachutist when the main parachute opens, and during this time he experiences a "shake up"-- a sign that the canopy of the parachute has opened. This is the so-called "dynamic shock"(opening shock).

In order to create more favorable conditions for the opening of the parachute, it is recommended that one conserve at this moment a position of the body such that the face will be turned downward. However, one should always remember that the parachute opens in a faultless manner with any position of the parachutist.

While awaiting the opening of the parachute, the jumper should keep the body tense, not turn the head to the side, press the reserve parachute to his body not bend the legs at the knees but keep them together.

After feeling the "dynamic shock", the parachutist must inspect the canopy in order to make sure that it is intact and that the opening has been correct.

If the parachutist, after the passing of 3 or 4 seconds from the moment of pulling the rip cord ring(and if he jumps with the parachute of forced action-- after 4 or 5 seconds after leaving the airplane), does not feel a sharp braking (or jerk) or if upon inspection of the canopy he sees that it has not fully opened or that the shroud lines/become entangled with the canopy, or if there are rents etc, he should immediately open the reserve parachute.

DESCENDING

After making sure that the canopy of the parachute has opened and is in good condition, the jumper should hook the rip cord ring to the special snap hook on the pack

of the reserve parachute(if the jump is made with a parachute of free action). After this he should take a seated position that is convenient for descending and landing. To do this he thrusts the thumbs one after the other under the main circular strap, moving it forward towards the knees(Figure 146).

After this the parachutist should orient himself as follows: determine the location of the airdrome, the place of landing and the direction of the drift. If he drifts with his face strictly forward in the direction of movement, the position for landing will be correct; if he has his back or side in this direction, the parachutist should turn his face down wind. He can determine the drift by observation of the movement of the visible objects on the ground and by the signal "T", put at the place of landing for the parachutists.

In order to turn left on the suspension system, the parachutist grasps the right pair of risers over his head with his left hand, and with his right hand he grasps the left pair of risers on the outside, and in doing this the left hand should pass between the left pair of risers and his body, and the right hand should be on the outside of the right pair of risers, and then, without releasing the risers, he should turn his arms to the sides. In order to turn to the right, he should take hold of the risers in the reverse order. In this way he can turn through 180 degrees (figure 147).

The turn should be made until the parachutist has turned erected down wind. In this position he should hold to the risers until he lands.

During the turns, as a result of the crossing of the risers and the arms, the field of vision is impaired. Hence, for observation of the ground, one should, after the turn, bring the head to the right or to the left and not cease to observe the ground.

The turn should be made in such a way that at a height of 100 meters the parachutist will be ready to land.

It is recommended that the parachutist practice the methods of turning and determination of the drift immediately after the opening of the parachute, because at a height of 200 meters the parachutist must stop this training and prepare for the landing.

LANDING

Landing is the final and responsible stage of the jump. It requires of the parachutist special attention and strict execution of all the rules.

After the turn down wind and at an altitude of not less than 100 meters the parachutist must prepare for landing. For this purpose his body should be in a semi-seated position with the feet put forward in such a way that the toes will be visible above the reserve parachute (between the thighs and shins there should be formed an obtuse angle). The legs should be brought together at the knees and the feet, the muscles of them should be slightly tensed, the feet on the same level and parallel with the ground.

One should land on the whole foot. After landing one should fall in the direction to which the parachute is drawn. In falling one should not put out the arms and rest the palms of the hands or the elbows against the ground. In all cases one should hold the risers with the hands on a level with the head or above.

The rules for landing should be observed very strictly. The parachutist should know these rules thoroughly, and be able to control his parachute and his body, achieving this by the jumps themselves and by systematic training on the apparatus in the parachute camp. One should not land with the legs spread out or on one foot. The legs pressed together at the knees, the feet together, not displaced constitutes a correct position even if one lands on the side.

With strong wind, when the parachutist lands with great progressive velocity, the legs should be brought forward more. This instruction pertains to the more experienced parachutist, because the first jumps are executed with weak wind.

Cases have been observed when a parachutist with little experience, upon approaching the ground, begins to "feel for the ground" and stretches out his legs, as a result of which he lands on an outstretched leg, thus increasing considerably the force of the blow.

The experienced parachutists, who have well developed the ability to estimate depth by sight, that is, the ability to determine distances to the ground at the moment of landing, can, while holding the risers with their hands, pull down sharply and in this way considerably weaken the blow received.

But this method is not recommended for beginning parachutists, because the pulling down, if not done at the proper time, causes an increase in the blow instead of a decrease.

When the landing is in strong wind, it is recommended that the experienced parachutist, with the permission of the instructor, while in the air, unfasten his leg straps and, before the landing itself, also the chest crosspiece, continuing to sit on one circular strap alone. In landing, this makes it possible to get clear of the suspension system instantly and to avoid dragging on the ground.

Parachutists who have mastered control of the canopy of the parachute during the descent can also control it successfully at the time of landing.

Let us consider the methods of controlling the canopy of the parachute at the time of landing. The parachutist, during the descent, changes his position in the air in two directions: vertically--with the speed of descent, and horizontally-- with the speed of the wind. The sum of these velocities shows that the parachutist lands with a speed greater than the vertical speed of descent. In calm weather the landing with a round parachute will be equal to the vertical velocity of descent.

How can we reduce the force of the blow against the ground? Of course, to do this it is necessary to reduce the velocity of landing, something which is possible to do by reducing the horizontal velocity. In a jump with a square canopy this is achieved by pulling down the rear risers or by a turn of the canopy with the large cutout forward--against the wind. The reactive force, exerted as a result of the large cutout, will be directed towards the side opposite the drift; hence, to reduce the horizontal velocity of the displacement means to reduce the speed of landing. In this case the parachutist should turn on the risers by 180 degrees.

If the canopy of the parachute is round, for reducing the velocity of landing it is also recommended that we pull the loose rear ends of the suspension system, as a result of which the lower edge of the parachute slips a little before the landing, braking and reducing the velocity of landing.

LANDING ON OBSTACLES

The danger of landing on obstacles may be the result of an incorrect estimate of the jump, a lack of care in the selection of the area for landing, or a sudden change in the meteorological conditions. In these cases it is necessary first of all to take advantage of all opportunities for the control of the canopy of the parachute in order to avoid landing on obstacles. But, if it has become necessary to land, we must act in accordance with the complicated situation.

First of all the parachutist should prepare just as for a normal landing, that is, turn down wind and bring his legs together. The legs should be slightly tense to meet the obstacles with the feet(Figure 148).

If the parachutist has to land in a forest, at a height of 100 to 150 meters above it, he should turn his face down wind, and meet the obstacle with his feet, protecting his face from striking against the trunks or branches of the trees, for which purpose he crosses his arms over his face, without releasing the risers, and draws his head in between his shoulders as much as possible.

To lower himself to the ground, he swings on the suspension system, and, seizing the tree trunk, reaches the ground. He can also open the reserve parachute and descend on its shroud lines and canopy.

One should remove the parachute from the tree very carefully, in order not to damage it, cutting off limbs if necessary.

If the parachutist lands on the reverse slope of the roof of a building without collapsing the canopy, he should jump from the roof without delay(Figure 149).

If the parachutist lands on the forward slope of the roof, he should immediately free himself from the suspension system. In all cases of roof landings the parachutist should prepare himself beforehand to get clear of the suspension system quickly.

If the parachutist drifts to a telegraph wire, or a high voltage line,he should try in every way to avoid the obstacle and should prepare beforehand to get clear of the suspension system quickly in case he should be left hanging from the wires. If collision with the wires is unavoidable he should hit them with his feet and push away at once, striving to prevent his body from contacting two wires at the same time. If the wire, under the weight of the parachutist, is torn loose, he should take the most advantageous position for a jump or fall to the ground(with his feet forward).

For descending from wires, to the ground, one also employs the canopy and the shroud lines of the reserve parachute.

If a parachutist lands on a separate hill or in hilly locality, he should first sit as low as possible on the circular strap, unsnap the snap hook of the leg straps, and then also the chest crosspiece, after which he frees his arms, one after the other, from the shoulder straps of the suspension system, turns his face down wind,

and brings his legs forward so as to meet the obstacle with his feet. After landing, the suspension system will slip from the parachutist.

Landing on the reverse slope of a hill is done in the same way but the legs should be bent under somewhat more than in the usual landing.

If after the landing the parachute drags the parachutist over the ground, it is necessary, for collapsing the parachute, to get on one's feet, if this is possible, and run after the canopy(Figure 150), and if he happens to be in a recumbent position, he should seize one or two of the lower shrouds and pull them to himself, until the canopy collapses(Figure 151). After this he should jump up quickly and run after the canopy.

To stow the parachute after the jump, the parachutist should unfasten (Figure 152) and take off the suspension system(Figure 153), unfasten the pack elastic straps of the main and reserve parachutes and tie them in pairs, pull out the canopy its whole length and shake it, removing the dust, insects or snow, rollup the canopy (if there is a pilot parachute also), gather up the shroud lines in an endless loop, put into the sack, on one side, the reserve parachute and the pack of the main parachute, placing between them the suspension system, then put into the pack, on the side of the pack of the main parachute the canopy with the shroud lines and the cover of the canopy with the pilot parachute.

USE RULES FOR THE OPENING OF THE RESERVE PARACHUTE, DESCENT AND LANDING ON TWO PARACHUTES.

The patriotic concern of the Communist Party and the Soviet Government for the men of Soviet aviation found its brightest expression in the words spoken in 1935 by I.V. Stalin to the great aviator V.P. Chkalov:

-Your life is dearer to us than any machine.

This is why, in spite of the fully reliable functioning of our Soviet parachutes, that in making jumps we take with us a reserve parachute, in order to be able to cope with any unexpected happening.

Our instruction documents specify that all parachute jumps in the aeroclubs of Dosaaf must be executed with parachutes in a set which includes a reserve parachute.

If after the opening of the canopy of the main parachute, the parachutist discovers rents in the canopy or entanglements of it with the shroud lines, then, in

the opening of the reserve parachute, he must observe the following sequence:

-he brings his legs together so that the canopy of the parachute and its shroud lines, when they are thrown from the pack, will not get between his legs;

-with his right hand he takes hold of the rip cord ring of the reserve parachute, and places the left on the flap of the parachute above;

-he should pull the ring(figure 154), leave it on the pack elastic and, taking the canopy with both hands(with the right hand on the side of the pack) throw it from himself with force under an angle of 45 degrees to the side and upward(figure 155).

After this, with his hands, he should facilitate the exit of the shroud lines from the cells of the pack, and by shaking the upper risers hasten the filling of the canopy with air.

It will be helpful, after the opening of the pack of the reserve parachute, while holding the canopy with the left hand, to release with the right the shroud lines from the pairs of cells, in order to provide the best condition for the release of the canopy.

By this same method one opens the reserve parachute, and, depending on the special task, even when the canopy of main parachute is open and in good condition.

If, however, after the pulling of the ring of the main parachute, the parachutist does not feel the jerk of the opening of the parachute, then, for placing the reserve parachute in action, it will suffice to pull its ring. Since the speed of fall of the parachutist in this case is greater, then within 2 seconds after the pulling of the ring of the reserve parachute its canopy is opened.

We must not open the main parachute when the canopy of the reserve parachute is open, because the shroud lines of the reserve parachute are shorter and if the main parachute is opened after the reserve, the canopy of the main one may get into the reserve and become entangled.

If when opened the canopy of the reserve parachute gets into the main one, we must by selection of the risers and the shrouds of the reserve parachute pull its canopy down until it comes out from the canopy of the main parachute and fills with air.

To control the parachutes while descending on two canopies and to turn with the face down wind, the parachutist pulls the left or right pair of risers of the reserve

parachute and holds its canopy before him.

In order to reduce the speed of descent at the time of landing one must reduce to a minimum the angle of camber between the canopies. To do this one must pull the inside risers of the reserve parachute(and still better, simultaneously also the inside risers of the main parachute) and bring its canopy to the main canopy.

Training in the opening and control of the reserve parachute should be given as a preliminary measure, before the jump, on the ground with the training parachute.

SLIPPING

Slipping is one of the methods of controlling the parachute in the air during descent.

Slipping may be shallow or deep.

Shallow slipping is employed for control of the parachute during descent. In doing this it is necessary to pull the loose ends of the risers from the semi-ring up to a level with the shoulders or chest but not more (figure 156). A part of the canopy of the parachute from the lower edge is pulled down and, consequently, the canopy itself changes its initial shape. On the opposite side(the one that is lifted) the air, by escaping, will create a reactive effect and, so to speak, push the canopy, as a result of which it will be shifted to the side of the edge of the canopy that is pulled down. While employing slipping during descent on a circular parachute, the parachutist may begin to rotate. When he does, he must release the riser and pull the other one on the side of the desired shift of direction. By this method he can increase the deviation, reduce it or move away to the side to a distance equal to one-fourth the height from which he started to control the parachute.

By periodic shallow slipping he can freely turn the canopy of the parachute by the necessary angle and place himself in the "plane of the wind" for landing, without having recourse to the crossing of the risers.

In the case of a parachute with a round canopy, one can reduce the velocity of landing by pulling, before landing, the rear pair of risers.

Deep slipping may be employed for rapid loss of altitude. However, one may employ it only with parachutes having a round canopy. In parachute jumps with a square canopy deep slipping is forbidden.

For deep slipping the parachutist pulls to himself two or three shroud lines or

better still a group of shroud lines from one of the risers, up to one -third of their length, as a result of which the area of the parachute is considerably reduced and the parachutist starts to lose altitude quickly.

The main attention in slipping should be paid to the position of the shroud lines selected for the slipping. Usually they can all be held in the hand or placed to the side near the legs, the latter being held together.

In releasing the shroud lines or risers to stop the slipping, it is necessary to do so cautiously in order to avoid burning the hands with them. One should also see that the selected shroud lines do not catch on the feet or on the reserve parachute.

The deep slipping is usually accompanied by rotation and swinging. Hence, it is necessary to stop it at an altitude of not less than 150 meters.

Swinging may be reduced and stopped by alternately pulling two pairs of risers on the side of the swinging(just as one stops it on swings).

In executing jumps for precision landing the most effective control of the parachute is by shallow slipping.

With square parachutes, employing a large cutout, we can shift the parachute in any direction by a turn of the canopy.

In order to make the canopy of the parachute turn to the right, it is necessary to pull and hold the 12th and 13th shroud lines on the left front riser of the loose ends of the suspension system, and for a turn to the left, one should pull and hold the 10th and 11th shroud lines on the right forward riser of the loose ends of the suspension system.

Slipping with two open canopies is forbidden.

THE MOST CHARACTERISTIC ERRORS OF THE BEGINNING PARACHUTISTS

If the parachutist has learned well the theory of the parachute jump, has had excellent training in the elements of the jump on the ground training equipment he should not make any errors in executing the jump. Errors may appear only as a result of carelessness of the parachutist, or a neglectful attitude towards the exercises.

Let us list certain characteristic errors made by the beginning parachutist in the execution of jumps:

-failure to repeat the command of the instructor and as a result of this not to execute it precisely in the preparation for the jump;

-in boarding the plane or climbing on to the wing of the airplane Po-2, because of carelessness, he damages the wing, by stepping on it outside the gangway;

-incorrect leaving of the airplane, in pushing away unevenly and abruptly he goes into a somersault during the free fall;

-at the moment of leaving he forgets to bring his left hand to the reserve parachute.

In the jump with manual opening of the parachute, the result of a premature opening of the main parachute may be that the main canopy will get caught on the stabilizer and the parachutist be left handing to the airplane. In this case he should cut with a knife the risers of the main parachute (or the shroud lines) and after clearing himself from the suspended position open the reserve parachute and descend on it. Until he has gotten clear of the main canopy a parachutist left hanging in this manner should not under any circumstances open the reserve parachute.

If for some reason the parachutist cannot cut the risers (or shroud lines) of the suspended parachute, the aviator must assist him in doing so.

Excessive haste on the part of the parachutists may lead to the opening of the reserve parachute simultaneously with the opening of the main parachute, something which is extremely undesirable, because the conditions for the opening of the parachutes in this case will be unfavorable. Hence, if after the pulling of the rip cord ring of the main parachute, the parachutist does not feel the jerk. He should make a quick movement with his whole body to the side in order to change the regimen of the fall. If even after this jerk it does not open, he should open the reserve parachute at once.

There have been cases when, after the opening of the canopy of the main parachute, the parachutist forgets to examine it and during this interval the parachute has either been damaged or has not opened fully. If the parachutist does not open the reserve parachute, his speed of descent in this case increases considerably and upon landing he may get bruises or other injuries.

With an incorrect position of the body at the moment of the opening of the parachute, its canopy may fall between his legs or under his arms, something which may lead to an undesired delay in the opening of the parachute.

The result of a poor fitting of the suspension system may be that the parachutist

will find it difficult or even impossible to assume the proper sitting position in the air.

The parachutist may start to prepare for the landing too late, as a result of which he does not have time before reaching the ground to turn his face strictly down wind, or, having turned just before the landing, he releases the risers, as a result of which he lands on his side or even on his back.

The failure to observe the correct position for the legs or "feeling for the ground" with his feet leads to a landing on one foot or on outstretched feet.

Because of incorrect arrangement of the circular strap of the suspension system, the parachutist, after the opening of the parachute, cannot give to his legs the proper position at the moment of landing.

In order to avoid these errors, the parachute instructor, before allowing the trainee to jump, should carefully check on the ground to see how well he knows the basic elements of the jump. In his turn, the parachutist should appraise critically his knowledge of all the elements of the jump, and if necessary practice them again on the ground apparatus.

JUMPS WITH DELAYED OPENING OF THE PARACHUTE

A jump with delayed opening of the parachute is one in which the parachutist leaves the airplane and falls freely in the air, without opening the parachute, for not less than 5 seconds. In a free fall a parachutist with a total weight of 85 kg acquires a critical velocity equal to 45-65 m/sec in 12-14 seconds of fall. The loss of altitude during this time is 500 -550 meters (in limits of altitude up to 2000-3000 meters). The organism of a healthy man can endure a long free fall without any damage.

Jumps with delayed opening of the parachutes help to develop in the parachutist strong will-power, courage and daring, the ability to orient himself quickly and they have great practical importance for each air sportsman. Under the conditions prevailing in battle they give to the parachutists an opportunity to escape the pursuit of the enemy in the air.

Jumps with delayed opening of the parachute may also be employed in the dropping of parachutists for the execution of special missions in the rear of the enemy.

In jumps from present-day fast airplanes, the delayed opening of the parachute is necessary in order to counteract the great initial horizontal velocity and at the same time to reduce the load received during the opening of the parachute.

We can achieve success in jumps with delayed opening of the parachute only by systematic training, by gradual transition from simple exercises to more complicated ones.

Our sportsmen parachutists, under the direction of experienced instructors, have achieved considerable successes in the mastery of this kind of jump, the complexity of which consists in the ability to keep the body in the most favorable position for the fall, by controlling it in the free fall, noticing at the same time the altitude and the time of falling.

For a parachutist preparing for jumps with delayed opening of the parachute, it is very important to practice the following elements on the ground: the technique of the control of the body in the free fall and skill in orientation(a clear idea of the regimen of the fall, that is, the position of the body); the ability to determine the distance travelled and the remaining distance to the ground; the ability to keep a check on the time of falling by counting off or with the help of a stopwatch; the abilityy in falling, to give to the body a position which will be most favorable at the moment of the opening of the parachute.

Before starting jumps with delayed opening, the parachutist should review carefully, in ordinary jumps, the basic elements of the jump: leaving the airplane, orientation in the air, and landing.

All jumps with delayed opening of the parachute must be carried out with a parachute device, as a means of insurance.

After mastering short delays, the parachutist gradually increases them in time. In doing this it is necessary to achieve the maximum accuracy in gaging the time of the delay. A deviation on either side by more than two seconds should not be allowed.

The determination of the time of the free fall can be done by ordinary counting. For mastering it with the maximum precision we use the ordinary counting off method of pronouncing two or three-digit numbers or even by pronouncing words.

It is recommended that we not count off to ourselves but aloud. In addition to this, it is necessary to train in this counting off method before the jumps, on the ground and in running, jumping, swinging etc.).

In delays of over 20 seconds the counting off method could be inaccurate. Hence, we should execute such jumps with a stopwatch which is fastened to the back of the left arm. The employment of the stopwatch enables the parachutist to pay more attention to the control of the body during the free fall.

In spite of the fact that the methods given above for determining the distance of the fall on the basis of time are sufficiently accurate, still we cannot depend entirely on either the counting off method or on the readings of the stopwatch, or even the parachute device. In a free fall the parachutist must constantly keep a check on the height by constant observation of the ground. For this purpose he must systematically train himself in visual estimate of depth, using for this purpose each flight he makes.

Usually, in all delays the parachute opens at one and the same altitude, namely, 800 meters. Hence, in the execution of flights at this altitude the parachutist should get a visual impression of the appearance of large objects on the ground visible from this altitude. It is recommended that one arrange for the parachutists some special flights in the area of the approaching jumps at the height of the opening of the parachute. It is no less important for the parachutists executing jumps with delayed opening of the parachute to be able to control their bodies perfectly in the period of the free fall.

The regimen of the free fall of the body in the air without control will rarely be constant. In the fall, the most convenient position of the body is that with the face downward, towards the ground, almost in a horizontal position (the "flatwise" fall) or under a small angle to the horizon with separation of the legs to the side and slightly bent at the knees. The arms should be brought to the side and forward and slightly bent at the elbows.

We can retain this position of the body in the free fall only by control, using for this purpose the arms as rudders. All the movements made during the control (excepting coming out from a corkscrew spin) should be smooth.

For parachutists who have not mastered the technique of jumps in which they find the ring of the rip cord in the air during a free fall, there is another method recommended for conserving a stable position of the body. While holding with the right hand the rip cord ring of the main parachute, the left hand should be placed

symmetrically with the right and the legs, straightened out at the knees, placed as wide apart as possible. In this case the regimen of the fall will be sufficiently stable, but with the head almost downward and the velocity of fall will be somewhat greater than the "flatwide" fall.

If the parachutist, during the time of a free fall, does not control his body, he may find himself in unfavorable positions. He will start to turn somersaults, to turn over, and, what is worst of all, he may fall into a corkscrew spin.

The corkscrew spin is the most disagreeable and the most disadvantageous regimen of fall.

The parachutist in a horizontal corkscrew spin starts to spin under a small angle to the horizon; his head is around the center of the rotation and describes small circles, and his feet, larger circles. As a rule, the parachutist in the corkscrew spin finds himself in a position with his back downward, because of the weight of the parachute which he has on his back. These are the basic characteristics of the horizontal or so-called flat corkscrew spins.

In the vertical corkscrew spin the parachutist falls with his face down and the angle of the inclination of his body with respect to the horizon is greater. The velocity of rotation in this case is considerably less, but it quickly increases and as a rule the parachutist, after this, goes into the flat corkscrew spin, falling with his back downward.

The parachutist falling in a corkscrew spin cannot orient himself and if he is not able to come out of this position, he should immediately open the parachute. The parachute in this case functions faultlessly, but in the time of its opening the shroud lines, under the influence of the rotation of the parachutist, start to twist and twirl, but after complete opening of the canopy they begin to untwist.

The best time to eliminate the corkscrew spin is when it starts, when the speed of rotation is still not great.

For coming out of the flat corkscrew spin, it is best to employ the method proposed by master of sport P. Storchienko. It consists of the following.

The parachutist with his back downward (the flat corkscrew spin) at the beginning of the rotation should immediately turn it, thrusting out one arm to the side and change to a controlled fall with his face down. However, with a strong rotation

it is difficult to change to a fall with the face down with the help of the arms alone. Then the parachutist must thrust one leg in the direction of rotation, bent at the knee, holding the other one straight, and place on arm to the side and the other over the head, as shown in figure 157.

The feet can also be placed in the form of scissors.

After stopping the rotation, the parachutist should press his left arm to his body, thrust his right one to the side, hold his legs together and straight(figure 158). The current of air turns the parachutist into the position with the face downward.

In order to avoid getting into a corkscrew spin during the free fall, the parachutist must learn to control his body in a skillful manner.

The appearance of the corkscrew position may be caused by a poor fitting suspension system, the uniform and equipment(the oxygen apparatus barograph etc.). In the execution of jumps with delayed opening it is necessary for the proper lacing of the center of gravity, that the pack of the reserve parachute be tied to the suspension system. This requirement must also be taken into account in the placing(or fastening) of the devices. In adjusting the suspension system we should see that the lower parts of the circular straps are in the correct position.

The transition to the corkscrew position can also result from hasty separation of the parachutist from the airplane, when he begins to fall with his head or his back downward. Hence, in leaving the airplane for execution of a jump with delayed opening of the parachute, one should do so without any abrupt pushes, and preferably at speeds of the airplane not exceeding 140-150 km per hour.

In leaving the airplane and passing to the regimen of the free fall, it is necessary to spread the legs to one side, straighten the body, put the arms to the side and thrust them forward, bending them at the elbows, as if resting against the contrary current of air. By the movement of the arms the parachutist can keep the position of his body almost horizontal, with his face downward. During the time of the fall the legs should be held semi-bent, in order not to change to a fall "on the head"(figure 159).

The world record holder, master of sport P. Storchienko, after mastering jumps with delayed opening of the parachute, not only in the daytime but also at night, describes as follows how to maintain stability during the fall:

"After leaving the airplane and getting into a falling position with the face downward, the parachutist thrusts his arms forward on the sides, smoothly and simultaneously, and keeps his legs apart the width of his shoulders. As the speed of fall increases, the resistance of the arms increases so much that it enables the parachutist to hold his body in the horizontal position. When the velocity of the free fall becomes steady, the parachutist, by means of his arms and legs, can hold his body under any angle with respect to the current of air and remain stable in this position for a very long time. It is recommended that the parachutist holds his body in a horizontal position with his face downward. By this means he achieves a considerable increase in the resistance, reducing a great deal the velocity, and, consequently, increases the time of the fall, making it possible for the parachutist to execute a delayed opening of the parachute under the best of conditions".

The honored master of sports of the USSR, V. Romaniuk, who holds the highest world records in parachute jumps, describes in the following manner his jumps with delayed opening of the parachute:

"The method of determining the time of free fall from any height to another given height is of the greatest practical interest to sportsmen. It may be determined more or less precisely for a duration of fall lasting only 15-20 seconds".

"In executing important delayed jumps, I most often determine the time of the opening of the parachute on the basis of the ground. During the fall one must see the ground and then with a certain amount of training one can determine the height within 100-200 meters, above or below, of the real height.

In the free fall the arms and legs play the part of rudders. I fall flatwise, after thrusting my arms and legs towards the sides. They rested so to speak against the air and maintained the necessary position of the body. In all cases it is necessary to see that the center of gravity is kept constant, taking into account the uniform, parachutes, devices, etc."

In the execution of jumps with delayed opening of the parachute, the whole attention of the parachutist during the period of the free fall should be directed to the ground, that is, he should orient the position of his body during the fall by the ground. The least tendency to disturb the established correct regimen of fall should immediately be eliminated by smooth and elastic movements of the arms and legs.

By abrupt movements (in contrast to the movements for coming out of the corkscrew spin), one can only make the position worse and not correct it, because abrupt movements cause the body to rotate.

If the parachutist leaves the airplane incorrectly, with a push, and goes into a somersault fall, he must come out of it also with the help of his arms and legs.

The training of the parachutists for jumps with delayed opening of the parachute should be conducted in strict sequence. The first jumps with delayed opening of the parachute should be executed with delays of not more than 5 seconds(about 100 meters of fall). In case of a free fall the parachutist must hold to the ring of the rip cord of the main parachute.

After several jumps with a delay of 5 seconds, in which the parachutist should master the free fall and acquire skill in determining the time and the distance of the fall, he passes to a jump with a delay of 10 seconds, etc.

With a delay of 5 seconds the jump is executed from a height of not less than 900 meters; with a delay of 10 seconds it is executed from a height of not less than 1,100 meters; and with a delay of 15-20 seconds, it is executed from a height of 1,350--1,600 meters.

After this the parachutist must practice jumps with a longer delay in the opening of the parachute, but in this case he should not hold to the ring of the main parachute. For this purpose the parachutist makes several jumps for training in finding the ring of the rip cord of the parachute after leaving the airplane in a free fall.

The parachutist, in practicing this exercise, in leaving the airplane, keeps both hands on the reserve parachute(as in the case of the jump with the parachute of forced opening). After complete separation from the airplane, he brings his right hand to the ring of the rip cord of the main parachute and opens it.

When skill in the rapid finding of the ring in the air has been acquired, the parachutist can pass to jumps with longer delay in opening the parachute(Table 16).

Table 16

Delay, in seconds	Jump from a height of not less than, meters
20	1600
25	1900
30	2200
35	2500
40	2800
50	3400

In the execution of these jumps, the parachutist controls his fall with the aid of his two arms and legs.

It is difficult to determine precisely how many jumps it is necessary to execute with delayed opening of the parachute for mastery of a given stage. This depends entirely on the individual qualities of the parachutist and on the course of the training, the appraisal of which should be made by the instructor.

All the jumps with delayed opening must be executed with a semi-automatic parachute device, set for a height of opening a little lower than the specified one. However, the parachutist in all cases should open the parachute himself.

In jumps with delayed opening of the parachute from a height of more than 4000 meters, it is necessary to employ the oxygen apparatus, and also, before the jump, to have the proper training on the ground in the thermobaro chamber or the baro chamber (see the section "Altitude Jumps").

Jumps with delayed opening of the parachute have a great future due to the enormous growth of our aviation technique and also because of the fact that parachute sport is recognized by our young people as one of the most interesting form of mass sport. Jumps with delayed opening rightfully enjoy a great popularity among our parachutists, because they make possible the development of daring, coolness, and strong will. Hence, this form of jump should become an indispensable part of the personal training of the parachute sportsmen.

The initiator of jumps with delayed opening of the parachute is Nikolai Evdokimov, who in 1932 executed a jump with a delay in opening of the parachute for 600 meters with a free fall of 14 seconds. At the present time the best record in this form of jump is held by V. Romaniuk, who in 1945 jumped in the daytime with a delay in the opening of the parachute of 167 seconds, falling freely a distance of 12,141.5 meters, and P. Storchienko, who jumped on 12 September 1952 at night with delayed opening of the parachute from a height of 10,800 meters; in free fall, he dropped a distance equal to 9276 meters. Among women the highest record in delayed opening of the parachute belongs to V. Seliverstova, who jumped on 12 September 1952 at night from a height of 9416 meters, descending in free fall a distance of 8326 meters.

The jump of P. Storchienko and the jump of V. Seliverstova are listed as world records.

ALTITUDE JUMPS

Soviet aviation is setting more and more records in altitude jumps. At the present time flights at high altitudes are ordinary occurrences and, hence, also the technique of high jumps must be perfected in every way possible.

The execution of jumps from great heights involves certain difficulties, but a careful study of the elements of these jumps, the appropriate ground training and preparation, and also the correct organization and conduct of the jump make possible successful overcoming of these difficulties.

Soviet parachute sportsmen have great success in mastering jumps from high altitudes, but these heights which they have reached are still not the limit for technology and the physiological capabilities of the human organism.

At the present time it has been shown that the parachute opens at heights of over 13,000 meters in a perfect normal manner, just as in the usual parachute jumps from a height of about 1000 meters. Of course, the load during the time of the opening of the parachute, as a result of the increased velocity of the fall of the parachutist, is somewhat greater but in no case does it reach such a value that it could exercise a detrimental effect upon the condition of the health of the parachutist.

Up to heights of 4000 meters, jumps are executed without oxygen apparatus; above this height, however, they are executed only with an oxygen device.

The complexity of the execution of jumps from great heights is due to a lack of oxygen and the necessity, both in flight and in the execution of the jump, of employing an artificial supply of oxygen. In addition to this, during the time of the stay at the great height the parachutist experiences more fatigue than in ordinary jumps, and as a result of this the task of leaving the airplane is more difficult.

The low temperatures at high altitudes make necessary the employment of a cumbersome uniform, a heavy oxygen apparatus, swimming equipment and devices for controlling the jump. The estimate of the jump(the place of landing) from great heights also involves certain difficulties.

All this obliges the parachutist to make careful preparation and to train on the ground before undertaking the execution of practical jumps.

The training of parachutists for jumps from great heights involves the following elements: regular practice in physical preparation, training in the barochamber (thermobaro chamber), training jumps from the intermediate heights.

The execution of the altitude jump should be preceded by careful preparation. This preparation consists of a study and training in the use of the oxygen apparatus, in the preparation of the devices, fixing and supervising the jumps, and also the uniform and parachutes.

Three or four days before the execution of the jump, the parachutist should be put on a special altitude diet.

The training and preparation for the jump should be conducted under systematic medical observation.

Let us consider separately each stage of the preparation of the parachutist for the altitude jump.

The supplying of the parachutist with oxygen during the flight when he reaches the required altitude is done by means of an oxygen apparatus installed on the airplane. Before leaving the airplane the supply of oxygen is shifted to the oxygen device of the parachutist. The parachute oxygen device is mounted separately and in the flight is mechanically connected with the airplane by one end with a cable; the other end has a pin which fixes the device. Upon leaving the airplane the pin is pulled out and the device automatically begins to operate; at this time the oxygen apparatus on board is shut off.

The functioning of the parachute oxygen device is checked in the thermobaro chamber at a temperature of minus 50 degrees up to an altitude somewhat higher than the altitude of the proposed jump, and then on preparatory flights and jumps.

The oxygen mask, for supplying the parachutist with oxygen, serves at the same time for protecting the face against freezing. It is fastened to the fliers helmet by an additional rubber band.

The flexible hose running from the oxygen device to the mask may be sewed, as a matter of precaution, in several places to the flying suit, avoiding in this way twisting and breaks.

In the preparation for the altitude jump(and also for jumps with delayed opening of the parachute from an altitude of more than 5000 meters,) the training in the baro chamber or thermo chamber is particularly important.

We know that when we reach a high altitude the atmospheric or barometric pressure decreases, because there is a gradual drop in the temperature. The amount of the drop in the temperature of the air is relatively constant and on the average is 5-7

degrees for each 1000 meters of increase in altitude vertically. The decrease in the atmospheric pressure takes place in a somewhat different manner: the higher we go, the less the drop in the value of the atmospheric pressure. For the first 1000 meters of ascent from sea level the atmospheric pressure drops on an average at the rate of 10 mm of standard mercury for each 100 meters of rise, while at 7000 meters altitude this drop amounts to only 5 mm.

The composition of the air does not change with altitude. Both at sea level and at a high altitude the air consists of 20.9% oxygen, 79% nitrogen, and 0.03 % carbon dioxide and certain other gases. One may ask, why then at a high altitude does the oxygen not suffice for breathing if the content of the oxygen in the air remains unchanged?

This is because with a decrease in the atmospheric pressure as we go up there is a drop in the pressure of each component part of the air, or in other words the partial pressure of the gases composing the air also drops, and the pressure of these gases is directly proportional to the percentage content of these gases in the air.

We call the partial pressure that pressure which the gas would have if it alone occupied all the space occupied by it at the present time in the mixture with the other gases.

What is most important for us is the decrease in the partial pressure of the oxygen. On the ground the pressure of the oxygen amounts to $\frac{760 \times 20.9}{100} = 158.9$ mm of standard mercury, while at an altitude of 5000 meters, where the atmospheric pressure is equal to 405 mm, the pressure of the oxygen amounts to only $\frac{405 \times 20.9}{100} = 84.14$ mm standard mercury and at an altitude of 10,000 meters it decreases to 42 mm.

This decrease in the partial pressure of the oxygen indicates a decrease in the mass (or quantity) of the oxygen of almost two-fold, a condition which forces the organism to expend considerable efforts in providing itself with the necessary quantity of oxygen. The change in the atmospheric conditions at a high altitude affects the organism unfavorably, limiting the possibility of its staying at this altitude.

For the study of the conditions, and also for training in staying at a high altitude, we have an apparatus called a barochamber and one providing a change in temperature, called a thermobaro chamber.

These apparatuses consist of airtight metallic rooms of various capacities. Communication with the barochamber is maintained visually (through glass windows), by telephone, light and sound signalization.

"Rising to an altitude" in the baro chamber is effected by sucking out the air from the chamber with a centrifugal pump. There is created the rarefication corresponding to a given altitude, with a decrease in the partial pressure of the gases entering into the composition of the air.

For maintaining the constancy of the composition of the air in the barochamber it is connected with the outside atmosphere, as a result of which fresh air is drawn from the outside in exchange for that used up. The more air sucked out in a unit of time in comparison with the inflow of fresh air, the quicker the rarefication will take place, or, in other words, the conditions prevailing at a high altitude.

In the thermobaro chamber, simultaneously with the "increase in altitude" there takes place also a drop in the temperature by the employment of a refrigerator installation.

Hence, by means of the baro chamber or the thermobaro chamber, we can "raise" the parachutist to any desired height and create for him the conditions prevailing when he is in rarefied atmosphere, raising and lowering him from any height and with any velocity corresponding to the conditions that will prevail in the parachute jump he is to make.

At first--in ascents to 5000--5500 meters--the parachutist trains in the baro chamber without oxygen apparatus, but for great heights he trains with the oxygen apparatus.

The duration of the training and the number of "ascents" will depend on the susceptibility of the organism of the trainee and the required altitude.

For the intermediate altitudes, and after this at the maximum altitudes(or the required ones), the parachutist, in full uniform and with the parachute and the oxygen device attached to him, should go through, in the baro chamber, all those movements which he will go through in taking the initial position for leaving the airplane, in leaving and for activity with the oxygen apparatus during the time of the descent on the parachute.

After the training in the baro chamber it is necessary to execute several flights

at high altitudes, and then make jumps from the intermediate altitudes. The flights at an altitude should be alternated with training in the baro chamber.

The flights should start from an altitude of 5000 meters, gradually increasing the height, and also the time of stay at the high altitude, up to 30-40 minutes.

In the flights it is recommended that we make so-called platforms at intermediate altitudes in order to give the organism of the parachutist an opportunity to get accustomed to the altitude. The flights should be executed in the same uniform and equipment with which he will execute the jump.

The uniform should be as light as possible but warm, not interfering with movements, but not too loose. As a rule one employs the ordinary winter flying suit. It is necessary to warm only the extremities. On the legs, felt boots, some good fur socks, and on the hands, on top of the warm woolen gloves--some gloves made of simple sheepskin. In flights at altitudes of more than 8000 meters, where the temperature may drop 55-60 degrees below zero, warm clothing becomes extremely important. In addition to the fur flying suit, one also needs some warm linen and good woolen overalls. The mask and the helmet should have a double fur lining.

For checking the altitude, the parachutist should have a stopwatch and an altimeter which should be fastened on the left wrist so that he can observe them constantly.

For determining the results of the jump the parachutist receives a prepared and printed barograph(or barospidograph), which gives the precise curve of the elevation, descent, height of jump and the height of the opening of the parachute.

The suspension system of the parachute is fitted precisely as for jumps with delayed opening of the parachute. Special attention should be paid to the correct fitting of the lower part of the main circular straps and the leg straps.

The parachutists going through the training for altitude jumps should observe a special diet. He should eat a minimum quantity of vegetable foods, not more than is necessary for the normal functioning of the organism.

Before the execution of the jump the parachutist should rest and sleep sufficiently.

For the altitude jumps there may be admitted only those parachutists who possess great endurance and skill, because the cumbersome uniform and equipment, and also the reduced atmospheric pressure require considerable physical efforts in making the

jumps and especially in the preperation for leaving the airplane.

When at a high altitude all useless movements should be avoided; one should avoid abrupt movements, because in making them one expends physical energy that is needed for other purposes.

A descent with an open parachute may be made with continuous swinging, which greatly fatigues the parachutist. For reducing the "bumps" one can open the reserve parachute. The oxygen mask should not be taken off until the landing itself (or at an altitude of not over 4000 meters).

The estimate of the place of the landing in high jumps is extremely difficult, in view of the fact it is necessary to be ready to land regardless of what the conditions in the locality are.

The estimate of the jump(place of landing) is made by the navigator or pilot on the basis of the pilot balloon data, by the usual method, after which the march route of the route is plotted on the map. The flight to the point of the drop should be made from a point a little farther away so that before reaching it the parachutist can prepare for the jump.

The place selected for the landing should be such that the parachutist can be observed from the ground. For this purpose one places here some observation posts, equipped with means of transport and signal communications and also posts for medical aid.

The first altitude jump in the Soviet Union was made in 1932 by Boris Petrov, who jumped without an oxygen apparatus from an altitude of 5200 meters. At the present time the world record is held by V.G. Romaniuk, who in 1947 made a jump from an altitude of 13,400 meters(a jump which he executed with oxygen apparatus).

Among the women who have made records in the high jump is E. Valdimirskaya, who jumped at night, in 1949, from a height of 10,370 meters.

JUMPS IN THE WINTERTIME

The technique of executing a jump under winter conditions is the same as in the summertime, but, because of the cumbersomeness of the uniform of the parachutist and the low temperature, there are complicated conditions in the preparation for the jump and for the action of the parachutists in the air, with the result that it is also difficult to control the parachute.

Jumps in the wintertime may be made provided the thickness of the snow cover is

not less than 10 cm and the strength of the wind on the ground is not more than 6 m/sec. The temperature should not be less than minus 20 degrees, and for East Siberia and the Far East, not less than minus 30 degrees.

Jumps should be made with a warm uniform, "valenoks"(a kind of felt boot) or high fur boots, with a warm helmet and fur gloves. The face should be rubbed with a special grease for protection against freezing.

Before the jump one should learn in the parachute camp, on practice equipment, all the elements of the jump in winter uniform.

In order that the parachutist may not slip in taking the initial position and in leaving the plane, the place of leaving the plane should be equipped with the proper antislip devices.

As a result of the change in the background of the winter surface of the landscape, it is difficult in the wintertime for the parachutist to determine the distance to the ground. Visibility above the canopies of the descending parachutists is also worsened. Hence, in group jumps from multiseater airplanes, it is necessary to observe a strict sequence in allowing the parachutists to leave the plane.

The cumbersome uniform and work with gloves on complicate the arrangement of the straps in descending. Hence, it is necessary to learn on the ground, beforehand, how to arrange them quickly.

If in the air one does not succeed in moving the circular strap and in taking a semiseated position, this position must be taken by the muscles of the back and the abdomen. Skills in doing this are also acquired by special training on the ground.

If there is a heavy snow cover, the shock at the moment of landing is reduced. But we also have hard snow covers, snow or ice crusts. The blow upon landing in such crusts is greatly increased. In such cases the turn down the drift should be executed very carefully, the legs should be held together and in a semi-bent position.

Because of the difficulty of moving over snow in the wintertime, it is recommended that the collapsing of the parachute be done by pulling the lower shroud lines.

The parachutists waiting on the airdrome for their turn to jump should go through light physical exercises for warming up. Special attention should be paid to the ability to work with the hands.

One should take all prophylactic measures against freezing. These measures have special importance in the planning of jumps from light engine open airplanes and especially in jumps when the airplane is doing stunt flying and also in jumps with delay opening of the parachute.

The duty officer on the area of landing should have skis for rapid movement in any direction.

JUMPS AT NIGHT

The making of parachute jumps at night is much more difficult than in the day time. This is due to the poor visibility, difficulty in estimating the place of the landing, if the jumps is executed without visible ground orienters at the points of leaving the plane and landing, and also the difficulty of the landing. Hence, for night jumps we admit only those parachutists who have mastered thoroughly the technique of the day jump.

In order for the parachutists to orient themselves in the night jump, it is necessary for them to make use of the reserve parachute quickly and precisely upon the appearance of the least malfunctioning of the main parachute. The checking of the opening of the main parachute is done by means of a pocket searchlight.

When jumps are made on moonlight nights, in addition to the light signals of the start, there are clearly visible outlines of the different ground orienters, on the basis of which one can determine the drift. But, it is difficult to determine the exact moment of contact with the ground; and, hence, one must prepare beforehand for the landing.

On a dark night it is difficult to see the ground orienters but on the general dark background the light points of the start stand out clearly. Forest and buildings stand out better with their dark tones. Bodies of water are readily visible, as well as highways and railroads.

For orientation in a turn for landing at night the parachutist should determine the drift beforehand on the basis of a clearly visible orienter.

Before the jump the parachutist should not look at the illumination devices on the airplane, in order not to be blinded temporarily.

The pocket flash lights of the parachutists should be of two colors, a white one and a red one. The parachutist employs the white light for illumination and giving

signals of his location and he employs the red one for giving signals in case anything happens after his landing. The signal should be agreed upon beforehand, with checking after this to see if the parachutists know them. In mass jumps, one may use at the moment of descent a signal (white light) for indicating the locality to the parachutist above. In order not to blind the parachutist, the signal should be brief.

The training of the parachutist for the night jump should be carried out in strict sequence: the training on the ground equipment and on the parachute tower at night, jumps from an airplane on a bright night, jumps from an airplane on a dark night.

It is recommended that the first night jumps be made in summer, because the cold and the cumbersome winter uniform render difficult the execution of a jump in the wintertime.

The laying out of the start for night jumps(on the area of the take-off and landing) is carried out in the same way as for the day flights and jumps.

Somewhat to one side of the place of landing there is set up a searchlight, so that if it is necessary one can illuminate the place of landing at the back of the parachutist.

For inspection of the parachutists before they board the airplane, the parachute instructor may employ various illumination means(a portable storage battery with a reflector or a stationary one with a long cable, an electrical pocket searchlight of increased illuminating power, automobile headlights, small projectors, etc.).

In case of the failure of a parachutist to appear at the place of the assembly after the jump, one should make a search for him. The observance of this rule is particularly important in group jumps.

The aviator instructor who drops parachutists at night should be well trained in night flights and the airplane should be appropriately equipped(illumination signals). The illumination in the front cabin should not be too bright, in order not to blind the parachutist.

JUMPS OVER WATER(WATER LANDINGS)

Jumps over water, just as jumps with delayed opening of the parachute, altitude jumps, night jumps, from planes doing stunt flying etc., require very careful preparation by the jumper, a thorough knowledge of the execution of these kinds of jumps, and exceptional ability to control the parachute and his body.

A jumper may not be allowed to jump over water until after he has a thorough

knowledge of the technique of the normal parachute jump.

Water landings are characterized by the fact that they require of the parachutist additional skills in clearing himself of the suspension system before reaching the water, and also a special organization of the servicing.

Before the practical jump over water, after learning the elements of it on the ground training equipment, the parachutist will execute the first jump of this exercise on dry land(on the airdrome or other landing area) in accordance with all the rules for the execution of a jump over water. These rules include the unfastening of the canopy of the reserve parachute and throwing it on the back, unfastening the suspension system in the air(the leg straps and the chest crosspiece), inflating the life belt. In descending on water the parachutist unfastens the suspension system in accordance with the usual rules for landing.

In doing the practice work for jumps over water, the jumps are executed with the usual training parachute.

For water landings, the parachutist should be dressed lightly: in the summer flying suit, sport shoes or cloth shoes and a helmet(also preferably of cloth). The parachutist also puts on a life belt. As a rule he also fastens to the circular strap of the main parachute on the left side a second life belt for giving buoyancy to the parachute. Before the jump he arranges it under the reserve parachute.

The methods of climbing onto the wing, leaving the airplane, opening the parachute and descending do not differ in any way from the methods employed in jumps on land.

After the opening of the main parachute and its inspection, it is necessary to seat one' self deeply on the circular strap of the suspension system. One should not open the reserve parachute, and after unfastening the snap hook of its pack the parachutist should place it over the head on his back.

After this the parachutist should unfasten the leg straps, and after this the chest crosspiece and inflate with two or three exhalations first the personal life belt(vest) and then the bolt for the parachute. Both floating means should be put on so that the parachutist can easily reach with his mouth the orifice of their mouthpieces.

After seating himself firmly on the circular strap, the parachutist, while holding the risers above his head, awaits the approach to the water. Upon touching the water with hisfeet he pulls down with his hands and, straightening his body, slides from

the suspension system.

With the aid of the life vest the parachutist can maintain himself freely on the water(Figure 160).

In water landings it is much more difficult to determine the height above the surface of the water, in particular the moment of touching it, than to determine the height above the surface of the ground. By reason of this fact, the jumper sometimes releases the suspension system too early, something which may lead to serious consequences if the body, at the moment of touching the water, assumes an unfavorable position. One should not release the suspension system until the feet touch the water.

In strong wind, especially if it is blowing toward the shores(or banks) a parachutist who has had sufficient experience in jumps over water may continue to hold to the suspension system with his hands and even after landing on the water. The wind will blow the canopy of the parachute like a sail and with a fair wind it can carry him up to the shore or up to the boat.

Before the jump the parachutist and the instructor should once again check the fitting of the harness. One should remember that for this kind of jump the chest crosspiece should be fitted in such a way that it can easily be unfastened. Superfluous slack in the leg straps is not permissible.

One should first carry out training in the unfastening of the harness, inflating the life belt and freeing oneself from the harness, on the equipment of the parachute camp.

At the place of the landing on the water, around the assumed place of descent, there should be some cutter rescue boats. The boats should be equipped with rescue means, with a speaking trumpet for giving instructions to the person descending in the parachute and a boat hook for drawing the parachute from the water. On one of the boats there should be a doctor with medicines. In the party it is necessary to have two or three excellent swimmers.

On the shore a place should be arranged for the assembly of the parachutists, a point for giving medical aid, land means of transport and devices for immediate preliminary drying of the parachutes. If there is no opportunity to dry the silk parachutes in the shade, one must carry out this drying immediately after the arrival in the aeroclub.

In order to avoid accidents mass jumps over water should not be allowed. In exceptional cases, if such jumps are necessary, the place for making the jump should be provided with adequate floating equipment and servicing personnel. In addition to this, the dropping of the parachutists in this case should be conducted at intervals sufficient to give an opportunity to gather up the descending parachutists at the proper time. In the educational organizations of Dosaaf only individual jumps over water are permitted.

Jumps over water are executed with a temperature of the water of not less than plus 19 degrees and a velocity of the wind on the ground of not more than 7 meters per second. The depth of the water at the place of landing of the parachutists should be at least two meters.

One may execute jumps over water with a land airplane and from hydroplanes.

For jumps over water one may admit only those parachutists who know how to swim.

Chapter VII

AIRDROMES, SIGNS, AND SIGNALS

A precise organization of the airdrome service is of great importance for the success of all the work in the preparation and training of the parachutists. The directors, parachute instructors and the parachutists themselves should strictly observe the rules of conduct on the airdrome, not allowing the least violation of discipline.

They should master thoroughly and execute precisely all the requirements laid down in the instructions for the organization and execution of the parachute jumps.

In the present chapter we shall give the general conceptions concerning airdromes (landing spaces), where the parachute jumpers prepare for jumps and execute them.

GENERAL CONCEPTIONS CONCERNING AIRDROMES

Parachute jumps are made only on airdromes or special landing places set aside and prepared for this purpose, meeting all the requirements both for lights and for jumps. These requirements are set forth in instructions dealing with the organization and execution of parachute jumps.

For the execution of jumps from the Po-2 airplane, it is necessary to have an airdrome or a space having dimensions of not less than 600 x 600 meters. They should

have good access roads and telephone connections, and also good approaches. By this we mean the absence near the airdrome of obstacles interfering with flights and jumps: forest cuttings, bodies of water, high voltage wires, structures, railroad and highways etc.

The disposition of the airdrome should make possible the execution of flights "in a circle". The "circle" (or rectangle) is for the execution of practice and training flights and also flights for carrying out the parachutists for the jumps.

The limit of the "circle" should pass at such a distance from the center of the "working area" as to give to the aviator an opportunity to execute the first turn in the limits of the "circle" at an altitude of not less than 100 meters, and the last turn before the landing, in the limits of the circle, with a run on a straight line (at a height) of not less than 100 meters and the possibility, from a height of 400 meters, to make an estimate for the landing by a turn of 90 degrees, without going beyond the limits of the "circle".

The laying out of the start(the day or the night start) is done in accordance with the requirements of the instructions for the organization and carrying out of parachute jumps.

If the parachute jumps are made on an airdrome(or other field), all other flights during this time are categorically forbidden.

In cases when our airdrome, for some reason or other cannot be used for the landing of parachutists, we should seek a "special landing field" from which one can also plan the take-off of airplanes.

As such areas one may use fields that are free of crops and meadow.

The area should have a level soft surface. It should be cleared of objects that might cause injuries to the parachutists at the time of landing. Around the area, in a radius of not less than 0.5-1 km, there should not be any obstacles interfering with flights and jumps: telephone-telegraph lines, high voltage wires, railroads and highways, buildings, ravines and streams. If near the area there are bodies of water or streams, one must have thereon the day of the jumps, in constant readiness, some rescue means.

The laying out of the start line on the area is done just as it is on the airdrome.

For the assembly of the parachutists after the landing and in case of the giving of the command and orders, there should be arranged some visual and sound signals, which should be known by all the director personnel and all those executing the jumps.

AIRDROME SIGNS AND SIGNALS

The signs on the airdromes are of two kinds, permanent and portable.

The stationary signs include the following:

Indicator of the direction of the wind, consisting of a cloth cone, set up on a large base on a metal ring with a stem, and turning freely on the base. The force of the wind fills up the cone and turns it in the direction of the wind. For better visibility, the cone has transversal strips--black and white. Sometimes the cone is replaced by a model airplane.

The indicator of the direction of the wind is usually set up on the edge of the airdrome, on a pole or on some building close to the meteorological station.

The indicator of the velocity of the wind is placed on the same pole together with the indicator of the direction of the wind and is called a field wind gage. In construction, this indicator is very simple. It has a wire frame in the upper part of which there is suspended freely a metallic plate. On the side of the frame, in its lower part, there is fastened an arched plate with the graduations of the scale on it.

The indicator of the velocity of the wind, since it is fastened together with the indicator of the direction of the wind, will always be in the "plane of the wind". Hence, the wind, depending upon its strength, turns the metallic plate under a definite angle and with its base indicates the division on the scale showing the velocity (strength) of the wind in meters per second.

The signs marking the limits of the airdrome--circles or squares, are made of wood or cement and painted white.

The portable signs include the markers for the start:

The landing "T", placed in the "plane of the wind" on the line of the precise landing of the airplanes and consisting of two panels having a dimension of 9 x 2 meters and 6 x 2 meters.

We have the limits of the landing, placed in front and behind the landing "T" and marking the limits of the landing zone. They consist of two panels each having dimensions of 6 x 2 meters.

Flags for marking and designating the landing and neutral strip, lines of the actua

and preliminary starts, the lines of the technical means, etc.

All the portable signs for better visibility are painted white in the summer and black in the winter. In the planning of fields at night these signs are replaced by lights --electric lights or kerosene lamps("bats"). In extreme cases bon fires are used.

The signals employed in the making of flights are the following:

Requests for the take-off: in the daytime the raising of the right hand; at night, the blinking of the lights of the airplane.

The start in the daytime : in the daytime the starter raises a flag (in the summer--white and in the winter--black) vertically upward and lowers it horizontally in the direction of the take-off, at night the same, but with the employment of a green lantern.

Forbidding the flight: in the day time, the lifting upward of a red flag and at night a red lantern.

Request for quick clearing of the landing and take-off strips: in the daytime the swinging of a white(or black) flag and at night by the swinging of a white lantern.

Request for a general landing: in the daytime at a distance of 5 meters in front of the landing "T" one places a panel parallel to the upper panel of the "T"; at night, this panel is marked with lights. Simultaneously with the start, one fires white rockets.

To stop the taxiing: in the daytime by the raising of a red flag and by night the raising of a red lantern.

Forbidding the landing: in the daytime-- a cross of panels of the landing "T",at night-- a cross of lights and the release of red rockets when the airplane comes in for landing.

Landing ordered on the left of the landing "T": parallel and to the left of the landing "T" and at a distance of 5 meters one places a panel with the dimensions of 6 x 2 meters.

The landing gear of the airplane coming in for a landing is out of order: the transversal panel of the landing "T" is brought forward by 5 meters.

The right side of the landing gear is in bad condition: the right side of the transversal panel of the landing "T" is bent down.

Left side of the landing gear out of order: the left side of the transversal panel of the landing "T" is bent down.

Landing gear is not in lowered position: instead of the landing "T", two parallel panels are laid out in the plane of the wind at a distance of 2 meters from each other.

The visual signals, placed on the area of landing for the execution of the parachute jumps:

T(landing "T")--the drop of the parachutists is permitted.

+ (cross of 2 panels) landing of the parachutists is forbidden.

-panel of landing "T". Return to your airdrome.

All the trainees for jumps should know thoroughly all these signs and signals.

The layoff of the start for the parachute jumps in the organizations of Dosaaf are carried out in accordance with the scheme given in figure 161.

The place for the landing of the parachutists, if the jumps are executed on the take-off airdrome, is assigned on the left of the take-off zone.

GENERAL ORDER ON THE AIRDROME AND THE RULES FOR MOVEMENT ON THE AIRDROME

For the general control of flights and jumps the following are appointed: the director of flights and jumps, a deputy director of jumps(commander of the parachute team), a duty physician, on duty at the place of landing. In the performance of their duties these persons follow strictly the instructions for the organization and conduct of jumps with parachutes.

The parachutes should be in a place assigned for them. The parachutists do not do anything of their own accord but do only what they are told to do by the commander of the parachute team, the parachute instructor and the packer instructor.

The parachutists may move over the airdrome only in formation, with permission of the commander of the parachute team, and in strict accordance with the general rules of movement on the airdrome during the time of flights and jumps. These rules permit crossing of the line of the take-off only from behind, and the landing line, only on the limits of the airdrome, and only when an airplane is not coming in for landing may one walk on the neutral strip, etc.

Before the beginning of the flights one should determine the sequence of the jumps and the placing of the parachutists on the airplanes. The boarding of the plane should be organized so that the airplanes will not spend time waiting for the

parachutists.

Boarding the airplane should not be allowed until after the checking of the jumper by the jumpmaster and the transporting parachute instructor, the commander of the team and the duty physician.

Smoking on the airdrome is allowed only in places set aside and equipped for this purpose and provided with sand boxes or kegs with water.

It is forbidden to bring on the airdrome easily inflammable substances and fuels without special permission for this purpose.

Only persons having special passes or crews coming upon request are permitted on the airdrome.

Chapter VIII

EXPLOITATION, STORAGE AND REPAIR OF PARACHUTES

GENERAL STATEMENT

By training, experimental, record and combat jumps made over the course of many years Soviet parachutes have shown themselves to be entirely reliable in jumps from any height, jumps with delayed opening, during any kind of weather, including rainy weather and cold weather.

With correct employment the parachute can last for many years without losing its strength and stability.

The checking of the exploitation and storage of the parachute property of the aeroclub is the duty of the chief of the aeroclub. The immediate responsibility for the condition of the parachute property falls upon the commander of the aviation team (flight) engaged in parachute training.

The parachute property in the aeroclub should be complete in every respect and be in good condition.

All parachutes received for use should be carefully examined, their completeness and suitability for operation should be checked and one should also examine their service list(data card) and the notations made on them and record the results of the inspection in the corresponding column of the service list.

In addition to the service list that accompanies it, the parachute should have with it a certificate. Each time when a parachute is packed, the packer and also the assistant and the one making the check should place on the certificate the date of the

packing and sign it. The certificate is the control document showing when the parachute was packed and is kept in the pocket on the pack of the parachute.

Without the certificate and the service list, the employment of the parachute for jumps, the parachute semi-automatic devices or the rip cords is categorically forbidden.

The service list is an indispensable part of the parachute, of the device and the static line and is drawn up by the one preparing it at the factory.

In case of loss of the service list it is necessary to inspect carefully the material on which it was drawn up, draw up a statement of the inspection and write a duplicate service list.

The entries in the service lists are made by the packer instructor. The entries should be made with ink in the proper columns, and written legibly without corrections or blots. No back dating is allowed in making entries in the service list or certificate .

On the service list of the parachute one should record the data concerning its packing, the jumps made with it, storage in the warehouse, airing or drying, and also concerning the results of inspection of the parachute and the character of the repairs made.

In the service list of the parachute semi-automatic device we should record all the data concerning the functioning of the device, both on the ground and in the air, the results of the checking of the device, and also concerning the repairs made.

In the service list of the static line we give information concerning its wear and tear in forced opening of the parachute and forced engagement of the line of the semi-automatic device.

EXPLOITATION OF THE PARACHUTES

The parachutist bears full responsibility for the conservation of the parachute issued to him.

It is forbidden to make a jump with a parachute in the packing of which the jumper has not participated. The instructor-packer, in issuing the parachute to the trainee, should check the service list or certificate to see whether or not he participated in the packing.

Silk parachutes should be repacked every month, and the percale parachutes

every fifteen days. These periods are valid under the conditions prevailing in normal storage of the parachutes.

Parachutes that have not been packed in the specified period may not be issued for jumps. They must be unfurled, checked and packed again. This pertains especially to the reserve parachutes of the training set, because the time to repack them is sometimes forgotten.

Parachutes exploited or conserved under improper conditions or packed in wet weather or in the wintertime in cold weather and left lying for more than 5 days should not be issued for jumps. They must be repacked.

Before the packing the parachute must be ventilated and dried, the canopy being suspended in such a way that it will hang freely and the shroud lines of the parachute and the pack should be spread out on a table or awning. The drying may also be done on the street, on special lines, but not in the sun and not in moist, windy, or rainy weather(Figure 162).

Drying each month for 3 hours will suffice for parachutes made of silk fabric, if they are used under normal conditions. Parachutes made of cotton fabric require a longer time for drying(not less than 24 hours). A silk canopy a normal percentage of moisture,should, when checked by its feel, show its characteristic crispness. The parachute should be dried until the oder of moisture has disappeared from it.

The parachute should be packed on a clean level table, in well-arranged quarters. The packing may be done on the street, in the shade but not in a dusty place. Before starting to work, the packer should put on clean clothing and wash his hands.

The parachutes are delivered at the airdrome in motor vehicles. In order that the parachutes may not be soiled, they should be covered with an awning, and the floor of the body of the vehicle should also be covered with an awning. The transportation and carrying of the parachutes is done only in the bags.

It is forbidden to sit on the parachutes or place any kind of weight on them. Neither in it permitted to transport the parachutes together with metallic objects, oils, gasoline, lyes and other property or materials capable of spoiling them. The parachutes should be unloaded very carefully and in no case should they be thrown out.

At the start line the parachutes should be placed in the proper order on awnings, at a sufficient distance from the starting place so that no dust will get on them.

One should not leave the parachutes in the airplane or shed nor in any place where there may be vapors of gasoline.

The parachutes falling in sea water or marsh should be washed clean with fresh water. For this purpose the canopy of the parachute should be suspended and a weak stream of water directed at it from a fire hose or water poured over it from a bucket.

It is forbidden to squeeze the water from the parachute.

THE STORAGE OF PARACHUTES IN STOREHOUSES

For storing, packing, drying, and repair of the parachutes, we should have light, dry heated quarters preferably with a wooden floor. One should have the following equipment:

-lockers or sets of shelves for the parachutes(the personnel parachutes should be kept separately from the cargo parachutes and the landing packing) (Figure 163);

-tables for packing the parachutes(Figure 164);

-packing accessories;

-devices for the drying of the parachutes;

-hydrometer for determining the relative humidity of the quarters;

-a thermometer for determining the temperature of the quarters;

-fire fighting equipment;

-the necessary supply of repair materials and a sewing machine for making minor repairs of the parachutes.

In addition to this, the parachute storehouse should have the following:

-diagrams and placards for the parts of the parachutes;

-graphs of the daily temperatures and humidity of the quarters;

-instructions, containing the rules for storing the parachutes, and also instructions prescribing the duties of the personnel of the warehouse;

-an issue and reception book and a journal for the registration of the parachutes.

The temperature of the air in the warehouse should be maintained within the limits of ± 10 to ± 15 degrees, and the relative humidity of the air should be within the limits of 40-60 percent.

The charts for the temperature and humidity should be filled out at the prescribed hours twice a day.

The place for issue of the parachutes should be separated from the place where they are stored.

In the quarters for storing of the parachutes, we are forbidden to store any other property, especially metallic objects, oils, acids, easily combustible substances, liquids and chemical substances. One must see that no rodents get into the warehouse.

It is strictly forbidden to sprinkle the parachutes with any kind of powders.

The sets of shelves and the windows should be equipped with curtains for protection against dust or the rays of the sun.

The shelves and lockers are arranged in such a way that the parachutes will be at a distance of at least 0.5 meters from the wall, floor and ceiling, and at a distance of at least 1.5 meters from heating equipment and water pipes. There should be a distance of at least 1 meter between the sets of shelves(or cupboards).

The height of the lockers and the sets of shelves should be such that the parachutes lying on top can easily be reached without the aid of a ladder.

On the cover, pack, and the first panel of the canopy of the training parachutes there should be sewed some red strips showing that these parachutes serve only for training in packing and that they are not suitable for the execution of jumps.

Under camp conditions, the parachutes should be kept in quarters not connected with the living quarters. For this purpose one may employ vacant dwelling quarters, sheds, barns, etc. In these quarters the parachutes are stored on wooden substructures having a height of at least 30 cm from the floor and in not more than 3 rows.

The parachutes turned over to the warehouse for temporary or long time storage should be unfurled, checked and packed in the bags. The pack of the parachute should be placed in the middle of the bag, on a rib, with the "cells"(loops) to the side of the bag where the cover is. On one side of it, namely, on the side opposite the sewed on "cells", we place the harness, and on the other side we place the canopy of the parachute with the shroud lines, but in such a way that the first panel with the factory mark will be on top and so that the canopy will be covered by the flap of the pack. After this the bag is fastened on all the fasteners.

The drying and ventilation of the parachutes stored under normal conditions are carried out at least once every three months, with mandatory notation of this fact in the service list.

If for some reason the parachutes are kept in wintertime in unheated quarters,

then it is best not to transfer them to heated quarters during the winter, the inspection and packing being carried out in the same cold quarters. But in this case the inspection must be carried out more often, as a rule, and in a particularly careful manner, if one discovers a moist parachute, then, in order to avoid the freezing of the fabric, it should be taken out and immediately dried very carefully in warm quarters. After the drying, the parachutes should be carried back into the warehouse, and after they have cooled to the temperature of the quarters, they should be packed.

When warm weather comes, parachutes kept in unheated quarters, should again be inspected and carefully dried.

INSPECTION OF THE PARACHUTES AND THE REJECTION OF THOSE THAT ARE UNFIT

The parachutes that are being used should be inspected at least once every three months for detecting the degree of their suitability for further use. The inspection is carried out by the packers and the parachutist inspectors of the aeroclub.

During the inspection of the parachutes, one should check to see if all the parts are present and inspect in succession: the pilot parachute, the canopy, shroud lines, harness, packs, pouch for carrying, flexible hose, pull ring of the rip cord, and one should check to see if there are any tears, cuts, threadbare places, traces of rust, stains, blots, odor of mould, traces of acid, or other chemicals, corrosion on the metal parts, places moistened by sea water, etc.

The results of the inspection should be given in the service list of the parachute and in the document for technical inspection.

Parachutes are divided into 5 categories depending upon the condition of the parachute:

1st category: parachutes which have not been in use, complete and having no defects. The absence of the service list does not constitute a cause for the placing of the parachute in a different category. In this case the training organizations should make out the duplicate for themselves.

2nd category: materiel formerly used and having no defects.

3rd category: materiel having defects but not sufficient to require sending to the factory, that is, they have defects which can be removed by the personnel of the training organization.

4th category: materiel having defects which can be removed in the factory and also rescue(or pilot) parachutes used for 10 jumps or having been in use for 4 years or stored under normal warehouse conditions for 9 years.

5th category: materiel having defects that cannot be removed or removal of which cannot be permitted.

In the determination of the quality of the parachutes one should be guided by "Provisional instructions for the condemnation of parachutes in the training organization of the Dosaaf of the USSR 1949".

REPAIR OF PARACHUTES IN THE AEROCLUB

In the aeroclubs one may repair parachutes having the following defects of the basic parts.

ON THE CANOPY AND SHROUD LINES

Tears of the canopy in the case of which the damage does not extend beyond the limits of one panel(in circular canopies) or a tear of a part of the canopy limited by seams and by the tape "framework"(on square canopies).

Separate insignificant tears of the tapes of the "framework" of the canopy.

Break at separate places in the stitches of the different seams within limits of not more than 10 cm.

Pulling off of the shroud lines from the lower edge of the round canopy without damage to the radial seam of the lower edge or cloth of the canopy.

Loops on the shroud lines, formed by the pulling out of threads of the braid or the core of the cord, torn threads of the braid, not more than two threads on one shroud line.

Spots of different origin not injuring the fabric--not morethan three on one gore and with dimensions of not more than 25 cm square.

ON THE HARNESS

Rents or slackness of separate threads of the seams of the tape of the harness.

A tear of the rubber bands and tears of the pocket of the ring of the rip cord.

A break of the spring of the snap hooks and the shearing off of the head of the clinchers of these springs.

ON THE RING OF THE RIP CORD

Places where the paint has been rubbed off the pull ring of the rip cord.

Light brown spots on the cable.

ON THE PACK

Torn threads in the seams and the threads with which the cells(loops) are sewed. Rents on the protective flaps for the pilot parachute.

Torn places on the apron for "soft" pilot parachutes.

Torn separate threads used to sew the cones.

Torn pack--places having a dimension of 10 cm square.

Threadbare places on the aviation canvas around the perimeter of the frame for rigidity.

Bad condition of the rubber straps(or tapes) of the cells.

Repairs of damages are not made on those parts of the pack where the cones and louvers are; neither are they made on the superposed bottom to which the cells are sewed. In these cases the pack is replaced by a new one.

ON THE CARRYING BAG

Tearing off of the handles of the bags. Torn places on the bag. Damage to the "tourniquets"(special buttons). It is permissible to darn the carrying bag.

The repair of the pilot parachute in the aeroclubs is permitted in case of the discovery of the same kind of defects as those mentioned for the main parachute.

REPAIR OF THE CANOPY AND THE SHROUD LINES

The repair of the canopy. On the damaged places of the canopy, patches are placed in the following manner.

A piece of the appropriate size and of the same fabric(silk or percale) is sewed to the inside of the canopy at the place of the damage, the direction of the threads of the patch being made to agree with the direction of the threads of the fabric of the canopy. After tacking, the patch should be sewed along the edge with fine white silk thread, by a lockstitch or an ordinary stitch. The sewing of the patches may be done on a sewing machine with the part of the seam having the same frequency of stitches as the seam of the canopy.

On the reverse side of the canopy, the edge of the tear should be smoothed out and sewed to the patch in the same manner.

The size of the patch to be put on should be twice that of the torn place. The patch and the seams should not shrink the fabric nor give it extra slack.

At the places of the rents on the "frame" tape, we sew the same kind of tape in such a way that the ends of the reinforcement will overlap the ends of the torn tape by 10 cm on each side. The tape should be sewed with fine silk thread.

The mending of local rents in the stitches of the seams is done by hand or a stitching machine with the same kind of thread as that used in the seams. In mending the stitches we should go beyond the good part of the stitch by 5 cm on each end.

A shroud line torn from its place at the lower edge of the canopy (without impairment of the condition of the shroud line) should be sewed back in place by hand with white silk thread, using a zigzag stitch. The torn places on the zigzag stitch fastening the shroud lines to the canopy are repaired only by hand with silk thread, without drawing the threads tightly, in order not to compress and destroy the stitch of the shroud line further on and so that the hand stitch will not only take in the separate threads of the shroud line but also spread over all the thickness of the shroud line.

We are forbidden to repair the loops of the canopy for fastening the shroud lines or to restore the stitches of the loop for the fastening of the shroud lines in the square parachute.

The loops of the threads of the core of the cord of the shroud lines should be arranged under the braid covering. The loops of thread of the braid covering of the cord of the shroud line should be arranged uniformly along the cord. The ends of the torn threads of the braid should be arranged under the braid of the cord.

The spots of different origins should be removed by washing with chemically pure benzol, rectified spirits or gasoline B-70, by means of a soft rag of silk fabric.

The employment of any other methods for removing the spots is forbidden.

The fabric of the canopy and the shroud lines of the pilot parachutes are repaired in the same manner as in the case of the main canopy.

In case of damages to the spring mechanism of the pilot parachute the spring should be replaced.

The repair of the harness or suspension system. Threadbare and torn threads used to sew the harness are reinforced by sewing with flax thread. When we reinforce the damaged stitches the patching should overlap the good part of the stitch by not less than 5 cm on each side.

In cases of damage to the stitches in the loops of the fastening of the metallic parts or in the knots for connecting the separate parts of the suspension system no repairs are made.

The torn off pocket for the ring of the rip cord or torn off elastic bands should be replaced with new ones. The new pocket is sewed on at precisely the place where the previous one was placed.

Broken springs and rivets with sheared off heads should be replaced. The place of the rivets should be covered with acetone varnish or emalite.

Quickly opening locks and other metallic parts of the harness, if damaged, are not repaired.

The repair of the rip cord ring. Light brown spots on the cord, pins, or body should be removed by wiping with a soft rag, wet with vaseline oil. Damaged paint on the rip cord rings should be replaced.

In case of damaged threads or solder of the cord at the places of connection of the rip cord ring with the cord, the soldering of the pins to the cord or cases of bent pins of the cord, one should replace all the ring with the cord.

The repair of the flexible hose. A light brown spot on the cover or the metallic braid of the flexible hose should be removed just as in the case of the rip cord ring.

If one discovers small worn places on the threads of the braid cover of the hose, a patch of aviation canvas should be sewed over them. Hose having torn places should not be repaired. A new hose should be sewed on precisely at the place from which the other one was removed.

The repair of the pack. Over places on the pack where there are rents, cuts, or threadbare spots with dimensions of not more than 10 cm square we place a patch just as we do on the canopy but it must be on the outside of the pack.

Threadbare or worn places on the pack, along the perimeter of the frame for rigidity, should be repaired by putting on and sewing strips of aviation canvas having a width of 5 cm or cotton tape of a camouflage color having a width of 4 cm.

Worn or torn stitches on the pack should be reinforced with coarse silk thread of a camouflage color, in the manner pointed out above.

Torn off flaps of the pilot parachute should be sewed on at the previous place with coarse silk threads of a camouflage color.

If louvers are torn from the flaps of a pack, this pack should be replaced by a new one.

Worn or torn threads used to sew on the cones should be reinforced with coarse silk thread. If cones come off it is forbidden to sew them on again.

Torn threads used to sew on the D-shaped wings of the buckle of the pack of the reserve parachute should be removed and the buckles sewed on again with waxed flax thread. Damaged elastic pack straps which have lost their elasticity should be replaced with new ones. In case of a break in the elastic frame of the pack, it should be replaced by a new one.

The repair of the bag. Torn off handles of the bag should be sewed at the same place with cotton thread of camouflage color.

Over the worn and torn places of the bag patches should be sewed as explained above.

The broken snap fasteners of the pack should be replaced by new ones. For this purpose a loop should be placed on the flap of the bag(sic.).

In all repairs of the parachute one should use only materials and parts listed in the nomenclature of parachute property.

Chapter IX

METHODS OF TRAINING

General Information

The director who is entrusted with the training of the parachutist has before him the task of developing him into a patriot, wholeheartedly devoted to the Soviet people and the Communist party, of developing him in an allround manner both in mind and in a physical sense.

In order to do this successfully, the director should know thoroughly the requirements to be met by the parachutist, have a clear idea of the goal, for the achievement of which he should strive in his educational training work. The director should strive to increase in a systematic manner the knowledge of the parachutist, teach him how to make parachute jumps, improve persistently and steadily the skill of the trainees and develop their psychic and physical qualities.

The basic organizers and directors of parachute training in the aeroclubs of the Dosaaf are the commander of the parachute team and the parachutist-instructor. Success in the training of the parachutists depends directly upon the degree of training

of these directors, on how rich and varied their experience is and how well they have mastered the art of the trainer.

The director must not only learn all the established forms and methods of training, but he should improve them and find newer and more effective methods of training.

But this means that the director must be not only a good parachutist and an aviator but also a good teacher, equipped with a definite sum of knowledge and skills and having an allround political and social training, possessing a high morale and qualities of will.

The parachute and flight training director should have the highest skill.

Inasmuch as the director is not a simple parachutist instructor but also a teacher and a trainer, he must have mastered the principles of pedagogy which reduces to a strict system all the information pertaining to questions of training and education.

By pedagogic skill of the director we mean his ability and skill in transmitting his knowledge to the trainees in a simple generally understood, interesting, and graphic form.

The director should be able to set forth the material clearly and expressively, to explain it in a way that it can be understood, giving convincing demonstrations, possess the ability to observe all the students(or groups) keeping at the same time within his field of vision each separate trainee.

METHODS OF PARACHUTE TRAINING

By the method of training we should understand the means by which the director transmits his knowledge to the trainee and develops in him the necessary skills and control his work.

In the training organization of the Dosaaf there have been set up unified methods for the training of parachutists. These methods shorten the period of training and make it possible for the trainees to master more quickly and more thoroughly all the necessary knowledge.

The basic method of training is a practical graphic demonstration with an explanation and employment of the method of action. It is necessary that the trainees receive the knowledge in a systematic sequence in order to facilitate a better absorption of it.

The selection by the director of a method of training depends first of all upon the following main factors:

Tasks and contents of the subject (the method of training changes with the content of the subject).

The instruction goal of the subject;

The composition of the group of students: general education and physical development, age and general educational training;

Specification of the given subject(one of the variants: observation of the subjects studied in a natural or laboratory situation, work with the objects studied, etc; other variants: the subject requires work with a book and demonstration illustrations by graphs, posters, pictures; the subject, giving the trainees all the knowledge and skills which it is necessary for them to employ in practice).

In the training of the parachutists it is recommended that the director employ the following basic methods.

Oral explanation. The oral explanation may be in the form of a narration, when the material does not require explanations; in the form of an explanation, when it is necessary to make a comparison, draw conclusions, etc and, lastly, in the form of a lesson--explanation of the problems or subjects.

At the beginning of each exercise, when it is conducted by the method of oral explanation, the director should establish the connection between the material just covered and the new material. This is done either by the method of recalling the conclusions drawn from the preceding exercises or by a brief questioning of the students for the purpose of determining how well they have mastered what was gone over previously. After this, the director gives the subject of the new exercises, acquaints the trainees with the training task and the importance of the new subject in the program or course.

After this the director explains the material and draws the proper conclusions, answers the questions and then begins to question the trainees in order to find out how well they have mastered the material they have gone over.

In the process of the oral explanation the director must ask the trainees some questions in order not to tire them and to concentrate their attention on the materials explained. The theoretical statements should be reinforced by examples from practice, in order to make the explanation accessible to every student.

The director must meet strict requirements in the matter of speech. It should be colorful, graphic, absolutely correct from the point of view of grammar and structure of the Russian language. The basic and chief statements should be made with emphasis.

During the time of the exercise it is necessary to observe the trainees all the time and react properly when there is doubt as to how well they have understood the material explained.

The presentation of the material should be strictly in accordance with the Marxist-Lenin point of view, on a high level of principle. The ability to select the facts, to explain them in a harmonious manner and to exhaust with them the basic questions of the subject treated will depend upon the degree of skill and experience of the instructor. Of course, the subject matter explained by the director should be absolutely reliable.

Special requirements are made of the lesson which is one of the forms of oral presentation.

Excellent lessons in a narrative form will be those containing a large element of description and reasoning and correspondingly less narrative material.

Before the beginning of the lesson it will be helpful for the students to write out its plan.

After the lesson, the director answers the questions of the students and in his turn asks the students some questions in order to find out how well they have mastered the material treated in the lesson.

The students should write in their notebooks, word for word, as dictated by the director, the conclusions from the lesson and the basic formulations. They should also write the dates, proper names etc. Words are that are not well understood should be written on the blackboard by the director. The basic conclusions in the notebook should be emphasized.

Conservation. Conversation is a method of training in which the students answer questions of the director or vice versa. In the process of a conversation the director can, to a much greater degree than during oral explanations, make individual approaches to each student and draw them into active participation in the exercises. However, conversation also has its negative sides: during a conversation it is impossible to explain the material systematically and time is wasted.

Hence, in the study of new material it is not recommended that this method be

used. But it is necessary in the review of material and for rendering more thorough and broader the knowledge obtained by the students.

Conversation is also conducted for the purpose of checking the thoroughness of the knowledge acquired by the students. Before conducting such a conversation the director should tell the students beforehand what the subject is and in the process of the exercise not deviate from this subject.

In posing of the questions the instructor should address all the students, in order that each one of them may participate in thinking out the answer. After this, the director (instructor) calls upon an individual student and if he cannot answer the question at once the director finds out the cause of the difficulty. He may ask the student a number of supplementary questions clearing up those asked earlier but prompting questions should not be asked.

The question should be clear and brief in form, leaving no room for different interpretations of it.

Each lesson and each conversation should awaken in the students a desire for further knowledge, arouse their interest,and stimulate their activity in the exercises. This can be achieved only on condition that the director conscientiously and carefully prepares for the exercise, selecting the necessary material and improving his form of presentation.

The illustration. Training should in all cases be graphic, accompanied by demonstrations and explanations. Hence, for each exercise, in keeping with its character, there should be present the materiel with accessories and other necessary property. Graphic aids are used for the study of the natural objects, phenomena and processes. The demonstration is the basic method for visual training.

In demonstrating a given object, the director should first describe it and then explain the parts. As an example, in studying the parachute, it is necessary at first to explain its purpose, give its characteristics and then pass to a study and demonstration of its basic parts and their interaction.

In other words the explnation of the objects, models, and representations should be conducted from the general to the particular. But, the explnation of the scheme should be conducted in the reverse order--from the particular to the general, explaining how one gets the whole from the separate parts.

In parachute training, extensive use is made of demonstrations, placards, sketches and diagrams. They enable the student to master the subject of study more quickly and better. However, if in the classroom one suspends placards, sketches, and tables which do not reflect the subject of the day's lesson, they will merely scatter the attention of the students. Hence, the classrooms should have placards, graphs, etc. which have a direct relationship with the subject of study at the given time.

During the time of the intermissions, and sometimes even after the lessons, graphic aids should be left in the classroom for independent study by the students.

One of the most popular forms of demonstration is the drawing made by the director on the blackboard. This form of demonstration requires of the director the proper kind of skill and continuous improvement in the technique of the illustrations.

Practical work. Practical work in the training of the parachutists, study of the parts of the parachute, packing them and the rules for correct exploitation, the study of the airdrome service, the laying out of the start line, acquaintance with the parts of the airplanes etc) are carried out under the direct supervision and control of the director.

Practical work is a method of combining theory with practice. The duty of the director in the conduct of this practical work consists in assigning a task and instructing the trainees as to the method of carrying it out, directing them in the process of the work, rendering them the necessary assistance and exercising control.

For the carrying out of the practical work, it is necessary to have adequate amounts of materials so that all the trainees may be occupied in the training work.

The materials should correspond to the subject under study and have no defects. For example, one cannot study the methods of packing a parachute when some of the parts are missing or some part has been damaged.

Demonstration. The demonstration is the most effective means of visual presentation. In application to the problems of parachute training it is in the main the learning of methods of jumping on training apparatus.

One must not confuse demonstration with illustration. An illustration is an explanation with the help of graphic appliances pertaining to the material. The demonstration, however, in its application to the problems of parachute training gives a graphic presentation of the actions of the parachutist in the parachute jump.

The demonstrations should be conducted in strict sequence, that is, with observance of the rules of transition from the simple to the complex. In the working out of these or other methods or actions it is necessary to have special precision and speed.

The demonstration should always be employed when we are teaching the actions of the parachutist in parachute jumps.

Conditioning(drill). In application to the tasks of parachute training the purpose of drill is to keep fresh and perfect the skills which the parachutist already has. It should develop in the parachutist the ability to subordinate his actions to the tasks of the jump, to appraise the situation in connection with these tasks and to make the correct decisions quickly.

ORGANIZATIONAL FORMS OF TRAINING WORK

The organizational forms of training work are determined by the goal which it is necessary to reach as a result of the exercises. In keeping with this goal, the director decides how best to occupy himself: with a group or an individual, whether the trainees should occupy themselves independently or under the supervision of the instructor, where to conduct the exercises, how much time one should spend etc.

In the conduct of parachute training we may employ the following basic organizational forms of training work: the group exercises; self training; consultation; prejump training; instruction-training jumps, demonstration jumps etc.

The group exercise is conducted in accordance with a plan and with a definite group of persons. It is the basic form of theoretical instruction and of practical exercises.

Self-training is an independent exercise for the purpose of consolidating and rendering more thorough the knowledge obtained and for the study of new materiel. Self-training may be conducted in an organized manner or individually.

Consultation is a form of exercise in which the director deals individually with each parachutist. The basic task in consultations is the explanation of problems and methods that have not been understood or that are not clear and the methods of independent work with the materiel and the explanation of the rules for keeping the notebook.

Pre-jump preparation in the training organizations of Dosaaf is conducted by an instructor in accordance with a previously drawn up plan, before the beginning of

the jumps on the airdrome. During the time of the training the instructor announces the task, explains the mission precisely and clearly, recalling the rules for carrying out the exercises and the basic elements of the jump.

The training parachute jumps are executed in accordance with the programs and the course for the training of parachutists in the training organizations of Dosaaf.

Demonstration jumps are conducted before each new exercise, and also before the beginning of the execution of jumps. The demonstration jump is executed by the parachutist instructor or by an experienced parachute sportsman in keeping with the approaching exercise.

SYSTEMATIC INSTRUCTIONS CONCERNING THE ORGANIZATION AND CONDUCT OF THE EXERCISES

Before starting the exercises, the commander of the parachute team should conduct a "training methods" exercise with the parachute instructors. The purpose of this exercise is to provide unified and systematic rules for the training.

In the process of training, it is necessary to devote special attention to the improvement of skills in rapid and correct packing of the parachutes. One should teach the packing of the parachutes by actual practice, with subsequent independent drill under the supervision of the director. In the training, it is necessary to have one parachute for each two trainees.

Ground training should be conducted in the same sequence as preparation for practice jumps from an airplane, accustoming the trainees to habits of organization and discipline. All the methods of the jump should be practical on the basis of the separate elements, on parachute training equipment at the parachute camp, so as to achieve in this way correct and precise execution of each element of the jump on each set of equipment separately and as a whole.

The exercises in the parachute camps should be organized so that the trainees will not spend time waiting their turn for the equipment.

The pre-jump training should be conducted before each jump and with each trainee.

The ground training includes learning the methods of landing on water, forest, and other obstacles.

Trainees may not be admitted for the execution of practical jumps until after they have learned thoroughly all the rules and methods of the jump on the ground

training apparatus, have passed an examination and taken the pre-jump training. Trainees who have not met these requirements must go through additional training.

In the schedule for the exercises the parachute jumps are replaced by exercises on other subjects, if, due to weather conditions the jumps have to be postponed.

Instructors and packers, in the process of training and drilling in the execution of jumps, should serve as an example of organization and a model of precise execution of all the elements of the jump.

GENERAL HINTS TO THE INSTRUCTOR(OR DIRECTOR) AS TO METHODS

Before the beginning of the exercises, the instructor should get acquainted with the trainees, by participating in the medical selection, conversing with the new recruits, getting acquainted with the reports of comrades and also with the reports received from the organizations in which the trainees have been working.

From the very beginning of the exercise the instructor must keep a personal notebook. In it he records his observations made in the course of the training process, remarks as to good points and bad points in the organization of the exercise, the conduct of the trainee, etc. A careful study of the characteristics of the students makes it possible to find the correct individual approach to each of them.

In the process of training the instructor should develop will power in the students and a feeling of confidence in their ability, and a spiriting of excellent discipline.

After explaining the history of the development of parachute work, showing and explaining the structure of the parachute, the methods of packing, the learning of the elements of the parachute jump on the training equipment, the instructor must emphasize that with correct exploitation the Soviet parachute functions reliably and without fail.

One must not allow to pass unnoticed even the most insignificant cases of inaccuracy, carelessness, or lack of caution by the trainees. If during the execution of the task the instructor discovers that the trainee executed it incorrectly, it is necessary to repeat the operations time and again on the ground training equipment. Right here it is necessary to explain to the students the consequences which may follow from the making of the least mistake in the execution of the methods of the parachute jump.

Of course, there may arise for the trainee a number of disturbing questions connected with the execution of the jump. The director must listen to these questions very carefully and give to the trainee each time an intelligent explanation, with an indication of the cause of the given undesirable phenomenon.

In all cases the instructor should tell the trainee only the truth, because attempts to conceal from the truth about any happening leads only to distrust on their part. After discovering the cause of the happening, the director should emphasize that it was the result of carelessness, lack of discipline, and the failure to obey the instructions and the regulations.

If the director himself is frank with the trainees, he can and should require the same of them. Mutual confidence is one of the necessary conditions for success of training.

One must create in the group a situation such that the trainee will turn to the director for explanations of everything or every question not clear to him about parachute training and not to his comrades, because the comrades for lack of acquaintance with and knowledge of the subject may give incorrect answers.

In the training one should not display nervousness, impatience, or roughness. The conduct of the director should be the exemplary relationship of a commander, chief and trainer towards the subordinate, that is, the student.

The assignment, clearly formulated, should be given to the trainee in the form of an order with obligatory repetition.

In the employment of disciplinary penalties and also encouragements, it is necessary to observe how these measures are reflected on the success of the trainee. In each separate case the director should ascertain whether the trainee has made a mistake or whether there was a lack of discipline. The mistake should be corrected by explanations, by demonstration and drill. In cases of lack of discipline, especially in the air and on the airdrome, the proper steps should be taken.

After the learning of each subject and exercise, the instructor should give a brief critique of the execution of the exercise, pointing out to each one in a quiet tone his mistakes. The instructor should never make coarse attacks against persons committing errors or refusing to jump. He should find out the cause of these phenomena and remove them.

The training of the parachutist should be conducted in the order of increasing complexity, and this means also in the order of increasing difficulty of execution of the exercise. Transition from the simple to the complex should be carried out gradually, taking into account the fact that each new subject develops and renders more thorough the preceding one.

The training consists of theoretical instruction and subsequent acquisition, by practice on the training apparatus(until the actions become automatic), of the skills necessary for parachute jumps from airplanes. Only after this, may one pass to the practical jumps.

It is necessary that each trainee, in the theoretical exercises, master thoroughly the theory of the jump and, in the process of practical ground exercises on the training apparatus(dummy airplane, suspended harness apparatus, parachute trainer, and the net, learn how to execute all the methods until there is conscious automatic action. The backward ones should be placed in a separate group and given intensive training on ground apparatus.

The success of the parachute training is ensured by political work and by the extensive development of the spirit of socialist competition among the trainees.

The Socialist competition should have a concrete character and be based on approximately the following indexes: excellent learning of the theoretical subjects, excellent training on the parachute apparatus, excellent exploitation of the parachute material, excellent packing of the parachute on the basis of quality and time, excellent execution of the exercises, etc.

The attention of the party and Komsomol organizations should always be devoted to the competition of the trainees. The personal example of the commander of the parachute team, and also of the other commanders and political workers, must play a great role in the development of socialist competition.

The directors of parachute training should be persons who are serious and thoughtful towards their duties and who enjoy authority among the trainees.

There are directors who treat the theory and practice of parachute jumps in a manner that is too simplified, and, there are also directors of a different type, who try to present their work and parachute jumps from airplanes as a matter which is very difficult. In conducting the exercises they tell about dozens of all kinds

of actual or imaginary accidents.

The director should remember that every physically able and morally sound person can make a parachute jump. This means that the problem of training the parachutist is to see that the latter receives, the necessary theoretical knowledge and goes through the basic training.

A poorly prepared trainee(one who has not gone through the necessary practical learning of the methods on the training equipment) will lack confidence in himself and may actually refuse to jump.

Directors with a careless attitude towards their work sometimes explain the refusal of the trainee to make the jump as "cowardice" "shock" etc. But in reality the whole fault for this lies entirely with the director himself. An experienced director with a serious attitude towards the training of parachutists does not allow such a trainee to jump and will occupy himself with him until he has an all-round training.

One should remember that each parachutist, even though he is one who meets all the requirements of the preliminary selection, is in need of a good deal of training. Besides, it takes longer to train some persons for jumps than it does others.

ORGANIZATION AND CONTENT OF THE EXERCISES

In the method of training for parachute jumps one should observe a strict sequence.

The organization and content of the exercises in parachute preparation in the training organizations of the Dosaaf are established and regulated by the course of parachute training and instructions for organization and conduct of parachute jumps.

For training of parachutists in accordance with the aforementioned course, one appoints for the organization and conduct of jumps persons having a special training and approved by order of the chief of the aeroclub.

The director should have a plan of exercises giving in a consistent sequence the basic problems of the subject, the time for studying them, indicating what training aids are required. For each exercise the director draws up a summary of the corresponding subject.

The content of the exercises should be rendered concrete in the training plan, programs, and textbooks.

The training plan contains basically the following problems: a list of the subjects of training; the sequence of the study of the subjects; the number of hours set aside for each subject; the date and place of the conduct of the exercise, method of conduct and conditions of execution.

The instructions for the programs of training of sportsmen parachutists in the training organizations of the Dosaaf of the USSR 1952 require the following:

p-In all cases one must finish the program of theoretical training before the beginning of the practical jumps;

--The sequence of the execution of the program should be observed in accordance with the established list of subjects and the number of hours for each catogory of sportsmen parachutists;

-In planning for carrying out the program of theoretical training it is permissible to combine into one group of parachutists those preparing for the 3rd and 2nd category, and in another group--parachutist sportsmen preparing for the 1st category and for masters of sport.

Picture Page 7--G.E. Kotelnikov(Picture) page 12-Ya. D. Moshkovski..(picture) page 13-V.G. Paranov.(Picture) page 22-N.A. Lobanov(Picture) page 23--V.D. Doronin, N.D. Doronin, A.D. Doronin(from left to right)(Picture) page 27-N. M.Shvetnova. (Picture) page 29--P.A. Storchenko. (Picture) page 33-V.M.Seliverstova.

Figure 1(page 44). Figure 2(page 45) Legend: 1-trajectory. Figure 3(page 46) Legend: 1-trajectory. Figures 4, 5 and 6, page 53. Figures 7,8,9, 10 page 54. Figure 11(page 55) Legend: A-form of body-Remarks. 1-cone. 2. cone. 3-cone-hemisphere. 4-cone -hemisphere-5- hemisphere -cup 6-cone-cup . B-arrow indicates the direction of the flow. Figure 12(page 55) Figure 13(page 56)-model of parachutist with parachute on(view from the front). Figure 14(page 56)-model of parachutist(view from the side). Figure 15(page 56)-position of the model in the wind tunnel. Figure 16 (page 58)-Figure 17(page 61)-Legend: 1 Velocity in m/sec. 2-t sec.
Figure 18(page 61)-Legend: 1 velocity in m/sec., 2-G 80 kg; 3-G 80 kg; 4-G 100 kg; 5-80 kg; 6-G 80 kg; 7 t sec.
Figure 19(page 63)-Legend: 1-first 500 meters; 2-path of fall with the average critical velocity. 3-T, total. Figure 20(page 65). Figure 21(page 65). Figure 21 (page 65)Figure 22(page 66) Figure 23(page 70). Figure 24(page 72). Figure 25(page 72);

Figure 26(page 73). Figures 27,28,29(page 85); Figure 30(page 86)-Legend: 1-panel; 2- "vee" piece; 3-factory mark. Figure 31(page 87)-Legend: 1-reinforced tape; 2-canopy; 3-spring mechanism; 4-shroud lines; 5-thimble.

Figure 32(page 89)-Legend: 1-Number of shroud lines; 2--semi-ring or D-ring; 3--shoulder buckle; 4--loose end; 5-Chest straps; 6--back shoulder straps7--Pocket for rip cord ring; 8--waist strap; 9--Main circular strap; 10--D-shaped buckle; 11-Snap hook PZ; 12-Leg straps; 13-Snap hook

Figure 33(page 91)--Legend: 1--Corner flaps; 2-Opening for the exit of the loose end; 3--flaps; 4--Additional flaps(flaps of the pilot parachute); 5--Frame for rigidity; 6--"Cells" or loops; 7--Flaps; 8--Plates for rigidity; Figure 34(page 90)--Legend: 1-Flexible hose; 2--upper flap; 3--Coat loop; 4--Pocket of the flaps; 5--Pin of the tourniquet; 6--Coat loops; 7--Right lateral flaps; 8--Tape for the fastening of the harness; 9--Louvers; 10--Cone; 11--Coat loop; 12--Pack elastics; 13--Left lateral flap; 14--Pocket for the servicelist; 15--Lower flap; 16--Coat loop; 17--Buckle - louver.

Figure 35(page 92)--Legend: 4--Pin; 1--line: 2--Body of the ring; 3--catch clamp.

Figure 36(page 93)

Figure 37(page 95): Legend--1--Weights; 2--Packing ruler; 3--Hook for packing of the shroud lines; 4--Auxiliary pins;5--Tie pieces; 6--Thread No. 30 --40; 7--Threads of flax; 8--Stamp tool; 9--Stamps and seals; 10--Wooden hook; 11--Table for the packing; 12--Packing linen; 13--Packing panel; 14--Cotters; 15--Knee pads; 16--Pouch.

Figure 38(page 96) Legend: 1--Rear loose end; 2--Front loose end.

Figure 39(page 96)--Legend: 1--Rear loose end of the harness; 2--Shroud line;

Figure 40(page 97)--Legend: 1--First panel; 2--Factory mark.

Figure 41(page 98)--Legend: 1--Factory mark

Figure 42(page 98)--Legend: 1--Shroud line No. 14

Figure 43(page 99)--Legend: 1--Shroud line No. 14

Figure 44(page 99)--Legend: 1--Shroud line No. 14 Figure 45(page 100);

Figure 46(page 100)--Legend: 1--Weights; 2--Factory mark. Figure 47(page 101);

Figure 48(page 101), Figure 49, Figure 50, Figure 51(on page 102); Figure 52 (page 103; Figure 53(page 103)--Legend: 1--Shroud lines of the rear pairs of loose ends of the harness; 2--Rear loose ends of the harness; 3--Packing ruler; 4--Pack.

Figure 54(page 103)--Legend: 1--Weights; 2--Packing ruler; 3--Shroud lines of the upper pairs of the loose ends of the harness; 2--Packing ruler; Figure 55(page 104)--Legend: 1--Loose ends of the harness; 2--Shroud lines; 3--Cells or loops;--4--Bottom of the pack;

Figure 56(page 105): Legend: 1--Hook for packing of the shroud line. Figure 57 (page 105). Figure 58(page 106): Legend: 1--Shroud lines of the canopy; 2--Weights; 3--Packing ruler. Figure 59(page 106). Figure 60(page 107) Legend: 1--Pilot parachute; 2--Pilot pull line; 3--Canopy.

Figure 61(page 107)Legend: 1--Pull(snap) line: 2--Flap for the pilot parachute; Figure 62(page 107): Legend 1--Flaps for the pilot parachute.

Figure 63(page 108): Legend: 1--Tie piece; 2--Louver. Figure 64(page 108); Legend: 1--Semi-cone; 2--Tie piece; 3--Auxiliary pin. Figure 65(page 109): Legend: 1--Pilot parachute; 2--Flaps for the pilot parachute. Figure 66(page 109): Legend: 1--Shroud lines of the pilot parachute; 2--Pilot parachute. Figure 67(page 110): Legend: 1--Lateral flap; 2--Flap for the pilot parachute; 3--The pilot parachute; 4--The flexible hose.

Figure 68(page 110): Legend: 1--Auxiliary pin; 2--Tie piece. Figure 69(page 11): Legend: 1--Tie piece: 2--Pin of the rip cord.Figure 70(page 111).

Figure 71(page 112) Legend: 1--Tie piece2--Pin of the rip cord.

Figure 72(page 113) Legend: 1--Buckle-Louver; 2--Packing ruler; 3--Tie piece.

Figure 73(page 113) Legend: 1--Tie piece; 2--Pin of the rip cord.

Figure 74(page 114) Legend: 1--Taking of the tie piece from the cones; 2--Corner and lateral flap arranged with a packing ruler.

Figure 75(page 114) Legend: 1--Pack elastics

Figure 76(page 116)--Legend: 1--loose ends; 2-loose ends; 3--semi-ring(D-ring). 4--cross piece; 5--No. of parachute; 6--fastening buckle.

Figure 77(page 117). Legend: 1--corner flaps;2--flaps; 3--opening for exit of loose ends; 4--rigidity frame; 5--cells (loops).

Figure 78(page 118)--Legend: 1-handle; 2-cone; 3-upper flap; 4--pocket flap; 5--buckle semi-ring; 6--louver; 7--cone;8-left lateral flap; 9--pocket for service list; 10--snap hook PZ; 11-pocket of the rip cord ring; 12-protective flap; 13-plate for rigidity; 14-louvers; 15-"tourniquet" bottom; 16-pins of the tourniquet;

17--right side flap; 18--Pack rubbers; 19--clasp of louver; 20--lower flap.

Figure 79(page 118)-Legend: 1-snap hook P3; 2-tape; 3-buckle.

Figure 80(page 118)--1-ring; 2-cable; 3-pins

Figure 81(page 120)--Figure 82(page 121)--Figure 83(page 121)--Figure 84(page 122) --Figure 85(page 122) Legend: 1--Tie piece; 2--Auxiliary pin--Figure 86(page 123) Figure 87(page 123)Legend: 1--Tie piece; 2--Auxiliary pin;--Figure 88(page 124) Legend: 1--Tie piece; 2--Pin of the ring of the rip cord--Figure 89(page 125) Legend: 1--Auxiliary pin; 2--Tie piece; 3--Packing ruler--Figure 90(page 125) Legend: 1-Tie piece; 2--Pin of the ring of the rip cord--Figure 91(page 126)Legend: 1--Tie piece; 2--Pin of the ring of the rip cord; 3--Packing ruler--Figure 92(page 126) Legend: 1--Cramp for fastening; 2--Intermediate suspension system;3--Number of the parachute; 4--Ring of the rip cord; 5--Pack elastics; 6--Protective flap--Figure 93 (page 127)Legend: 1--Cambered buckle; 2--Main circular strap3--Fastening cramp 4-Intermediate suspension system; 5--PZ snap hook--Figure 94(page 128)--Figure 95 (page 129)--Figure 96(page 129) Legend: 1--Pockets; 2--Double shroud lines; 3--Rear loose ends of the suspension system of harness; 4--D-ring--Figure 97(page 130) Legend: 1--Pocket; 2--Tape of the framework; 3--Factory mark--

Figure 98(page 131) Legend: 1--Flaps; 2--Corner flaps; 3--Opening for the passage of the loose ends; 4--Additional flaps(flaps of the pilot chute); 5--Cells or loops; 6--Frame for rigidity; 7--Flaps; 8--Plates for rigidity; 9--Shroud lines are to be packed in the cells of the pack only when we pack the parachute without a canopy cover(see instructions).

Figure 99(page 132)Legend: 1--Flexible hose for the rip cord of forced opening of the pack; 2--Upper flap; 3--Flexible hose for the rip cord of emergency pull ring and the cord of the rip cord ring; 4--Pockets of the flaps; 5--Ring for fastening the hose; 6--Protective flap; 7--Tape for fastening the harness; 8--Fasteners of the tourniquet; 9--Pins of the tourniquet; 10--Pockets for the static line; 11--Right lateral flap; 12--Ring for the fastening of the static line; 13--Sleeve for the passing of the pack elastics; 14--Pocket for the flap snap of the static line; 15--Lower flap; 16--Pocket for the service list; 17--Louver; 18--Cone; 19--Pack elastics; 20--Left lateral flap; 21--D-ring for the fastening of the cords holding the load.

Figure 100(page 133) Legend: 1--Apron; 2--Cells(or loops); 3--Cover of the canopy;

4--Loop of the bridle of the cover; 5--Pocket.

Figure 101(page 135) Legend: 1--Loop; 2--Service list; 3--Loop for fastening; 4--Snap hook.

Figure 102(page 135)--Figure 103(page 136)--Figure 104(page 137) Legend: 1--Tape tie pieces; 2--Protective cover; 3--Sleeve. --Figure 105(page 140)--Figure 106(page 141) --Figure 107(page 142) Legend: 1--Factory mark--Figure 108(page 142) Legend: 1--Factory mark--Figure 109(page 143) Legend: 1--Stitch perpendicular to the tape "frame". --Figure 110(page 143)--Figure 111(page 144) Legend: 1--Weights; 2--Factory mark.

Figure 112(page 145)Legend: 1--Pilot parachute; 2--Connecting shroud line--Figure 113(page 145) Legend: 1--Pilot parachute; 2--Cover of the bridle; 3--Knots may or may not be tightened, depending on what is agreed upon; 4--Eye of the pilot parachute.

Figure 114(page 146) Legend: Packing frame; 2--Cells or loops; 3--Hook for packing the shroud lines; 4--Detachable cells; 5--Shroud lines; 6--Apron of the cover.

Figure 115(page 146)Legend: 1--Packing frame; 2--Protective flaps

Figure 116(page 147) Legend: 1--Canopy of the parachute in the cover of the canopy; 2--Bottom of the pack--Figure 117(page 147)--Figure 118(page 148) Legend; 1--Connecting shroud line; 2--Pilot parachute; --Figure 119(page 148) Legend: 1--Flap for the pilot parachute

Figure 120(page 149) Legend: 1--Loop of the static line; 2--Loop of the rip cord

Figure 121(page 149) Legend: 1--Cover protective; 2--Tape for tying; 3--Sleeve; 4--Snap hook; 5-Static line; 6--Sleeve tightly wrapped with tape in 4 turns and tightly fastened with a bow knot;7--Pocket of the service list; 8--Static line; 9--Protective cover; 10--Rip cord; 11-Loop of the cord; 12--Flexible hose;13--Diagram of the tie knot.

Figure 122(page 150) Legend: 1--Knot for fastening of the line; 2--Flax threads having a strength of 15 kg; 3--Protective cover; 4--Protective cover; 5--Flexible hose; 6--Rip cord; 7--static line; 8--In packing the static line in the pockets of the pack, the loop of the static line should not extend from the protective cover; 9-Snap hook; 10--Fastening(cotton thread No. 10)

Figure 123(page 151) Legend: 1--Warning plate with the following inscription: "Shroud lines to be packed in the cells or loops only when packing the parachute

without the canopy cover(see instructions).; 2--Cells or loops; 3--Loose ends of the harness; 4--Shroud lines; 5--Bottom of the pack; 6--Hook for packing the shroud line --Figure 124(page 152) Legend: 1--Packing ruler; 2--Snap or break line; 3--Peak of the canopy.

Figure 125(page 152) A-- Pull shroud line; B--A warning plate with the inscription: "Tie the following to the loop: 1--Break(or pull) shroud line only in packing of parachute without the canopy cover; 2--Connecting shroud line in packing of the parachute with the canopy cover(see instructions); C-Knot may or may not be tied; D--Loop of the canopy

Figure 126(page 153) Legend: 1--Break shroud line; 2--Loop of the rip cord

Figure 127(page 153) Legend: 1--Loop of the static line; 2--Place for tying the static line to the loop of the rip cord; 3--Static line; 4--Snap hook;5--Pocket for the service list.

Figure 128(page 154) Legend: 1--Diagram for the tying of the bridle of the canopy to static line; 2--Canopy; 3--Line; 4--Snap line; 5--Knot for fastening the line; 6-Flax threads having a strength of 15 kg; 7--Snap line; 8--To the bridle of the canopy.

Figure 129(page 155) Legend: 1--Number of the shroud lines; 2--Factory mark; 3--Tape framework; 4--Roman numbers designate the number of the panels and the ordinary or Arabic numbers indicate the squares of each of its panels.

Figure 130(page 157)--Figure 131(page 158)--Figure 132(page 164)--Figure 133 (page 168)--Figure 134(page 169)--Figure 135(page 171)--Figure 136(page 175)--Figure 137(page 179)--Figure 138(page 181)--Figure 139(page 182)--Figure 140 (page 186)--Figure 141(page 203)--Figure 142(page 203)--Figure 143(page 204--Fig. 144(page 204)--Figure 145(page 205)--Figure 146(page 208)--Figure 147(page 209)--Figure 148(page 211)--Figure 149(page 212)--Figure 150(page 213)--Figure 151(page 213) --Figure 152(page 214)--Figure 153(page 214)--Figure 154(page 215)--Figure 156 (page 217)--Figure 157(page 223)--Figure 158(page 223)--Figure 159(page 224)--Figure 160(page 236)--Figure 161(page 242) Legend: 1--Starter; 2--Director of flights; 3--Time keeper; 4--Surgeon; 5--Line of the executor of the start; 6--Square for the preparation and placing of the parachutes; 7--Square for the stationing of the parachutists;8-Refueling repair line; 9--Place of waiting and boarding of the

airplane by the parachutists; 10-Finisher; 11--Approximate dimensions are given in meters .

Figure 162(page 246)--Figure 163(page 247)--

Figure 164(page 248)Legend: 1--Table for packing; 2--Folding supports;